United States Department of State

Bureau of Political-Military Affairs
Directorate of Defense Trade Controls

Washington, D.C. 20520-0112

In Reply Refer to
DTC Case **TA 2815-06**

JAN 08 2007

Ms. Catherine M. Clark
Analex Corporation
2677 Prosperity Avenue, Ste 400
Fairfax, VA 22031

YOUR LETTER DATED: September 25, 2006
AGREEMENT FOR: Technical Assistance
FOREIGN LICENSEE: Centre National d'Etudes Spatiales – France
COMMODITY: Technical Data and Defense Services for Ocean Surface Topography Mission Satellite

Dear Applicant:

The Department of State approves the request as identified subject to the limitations, provisos or other requirements stated below. The agreement may not enter into force until these requirements have been satisfied. The applicant must submit any request for extension to this office for approval no later than 60 days prior to the authorized expiration date.

Sincerely yours,

Susan M. Clark
Director
Defense Trade Controls Licensing

LIMITATIONS, PROVISOS AND OTHER REQUIREMENTS:

1. This authorization **expires March 31, 2011.**

2. Sublicensing/retransfer is not authorized under this agreement. If sublicensing/retransfer is contemplated, the applicant must receive prior written approval from this office to an amendment or proviso reconsideration request

describing the purpose of the sublicensing/retransfer activity, the data to be transferred, and the individual parties involved.

3. No US signatories may export or temporarily import hardware, software, technical data or defense services against this agreement until all parties have executed the agreement. In accordance with 22 CFR 124.4(a), submit one copy of the signed agreement, revised as may be required herein, to this office no later than 30 days after it enters into force. The applicant must inform this office within 60 days of a decision not to execute this approval.

4. If the agreement is not executed within one year of this approval, a written report as to the status of the agreement must be submitted to this office on an annual basis until the requirements of 22 CFR 124.4 or 22 CFR 124.5 have been satisfied.

5. Export or temporary import of hardware in furtherance of this agreement under the provisions of 22 CFR 123.16(b)(1) or by separate license **is not authorized**. Export or temporary import of hardware may take place only after this office approves an amendment to the agreement authorizing such shipments.

6. Employees of the foreign licensees who are nationals of a third country (includes "dual nationals") are not authorized to receive any defense articles or services under this agreement. Transfers to employees of the foreign parties who are nationals of a third country may take place only after this office approves an amendment to the agreement which identifies countries of origin and nationality. **Prior to execution**, the applicant must add language to the agreement to make it consistent with this proviso.

7. **Prior to execution**, the applicant must add signature blocks to the agreement for both signatories.

EXHIBIT 1

Technical Assistance Agreement (TAA)

Technical Assistance Agreement for OSTM

This agreement is entered into between Analex Corporation (Analex), an entity incorporated in the state of Virginia with offices at 2677 Prosperity Ave, Suite 400, Fairfax, VA 22031, USA and the Centre National d'Etudes Spatiales (CNES), a French agency with offices located at 2 place Maurice Quentin, 75 039 Paris Cedex 01, France, and is effective upon the date of the last party to sign the agreement.

WHEREAS Analex will provide technical assessment and mission qualification pre-launch services for the Ocean Surface Topography Mission (OSTM) satellite to CNES under its Expendable Launch Vehicle Integrated Support (ELVIS) contract with the National Aeronautics And Space Administration (NASA); and

WHEREAS OSTM is a cooperative effort between NASA, CNES, the National Oceanic and Atmospheric Administration (NOAA), and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT); and

WHEREAS NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif., manages the U.S. portion of OSTM for NASA's Science Mission Directorate. JPL is managed for NASA by the California Institute of Technology. JPL co-partners with CNES on OSTM, who manages the French portion of OSTM (which CNES refers to as Jason-2). OSTM is scheduled for launch in June of 2008; and

WHEREAS CNES will provide the PROTEUS platform and payload module; NASA and CNES will jointly provide the payload instruments; NASA will provide launch services for the satellite; CNES will provide a command and control center for the satellite, a European Earth Terminal and data processing, archiving and distribution infrastructure for the mission; NOAA will provide a control center for the satellite, command and data acquisition stations and data processing, archiving and distribution infrastructure for the mission; and EUMETSAT will provide a site and infrastructure for accommodation of the European Earth terminal, to be integrated into the EUMETSAT Ground Segment infrastructure and data processing, rolling archiving and distribution infrastructure for the mission.

WHEREAS Analex previously has exported to CNES under the ELVIS contract for the CALIPSO mission, reference TAA (AG) 0966-04,

NOW THEREFORE, the parties desire to enter into the Technical Assistance Agreement as follows:

1. NASA has negotiated a formal Memorandum of Understanding or MOU (ANNEX A) with CNES that has the former agree to use its launch services contract to launch the co-developed Jason-2 satellite to support its operations once on orbit, checked out, and functioning; and to share the Earth science data that OSTM will produce. The MOU calls for the signatories' centers and contractors to produce a detailed breakout of the tasks and responsibilities of the

parties called a OSTM Project Plan (ANNEX B) that shall be empowered by the MOU and have the force of an international cooperation agreement concluded by NASA and CNES on its behalf.

CNES has contracted with Alcatel, the builder of the PROTEUS spacecraft bus, for the OSTM spacecraft bus. CNES, has contracted with Alcatel, to provide the Poseidon-3, dual-frequency radar altimeter with its antenna, and has contracted with Thales, to provide the Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) receiver package. CNES/Alcatel will integrate the payload and the spacecraft and operate the spacecraft once it is on orbit. NASA will provide an Advanced Microwave Radiometer (AMR) with its antenna, a laser retroreflector array (LRA), and a Global Positioning System Payload (GPSP) receiver package.

NASA has contracted with Analex to perform a launch site support role; a safety and mission assurance oversight role; a launch day operations management role; a mission integration coordination role; a communication and telemetry support role; to provide technical services to the NASA/Analex Launch Engineering Team (LET); provide on-site technical, security, and administrative support; to provide mission analysis of the following analytical areas: Loads and Structural Dynamics, Dynamic Environments, Stress, Flight Design, Flight Software, Controls and Stability, Thermal/Thermodynamics, Electromagnetic Compatibility & CFD/Aerodynamics; and perform engineering and analyses for the NASA Launch Services Program, which necessitates this agreement.

This Technical Assistance Agreement (TAA) is required so that Analex can carry out its responsibilities. Analex personnel will perform their work on site at Vandenberg AFB (VAFB), California and Kennedy Space Center (KSC), Florida before the launch campaign portion of the mission and then at VAFB for the launch campaign portion of the mission, in order to get the Boeing Delta II launch vehicle and OSTM payload integrated and ready for launch, and other tasks required of it by the OSTM Project Plan and the ELVIS contract Statement of Work (SOW) (ANNEX C).

Analex must be able to work closely with the U.S. launch services provider, The Boeing Company (Boeing), and with the French payload Partner, CNES. Analex' work with Boeing and CNES may involve any or all of the services, tasks, and technical data described in the OSTM Project Plan and the ELVIS SOW. That is, Analex must be able to provide oversight and assurance during the integration of the spacecraft payload with the launch vehicle, help to solve engineering and technical problems that are encountered during integration, and to perform other, integration related work with Boeing, CNES and NASA at Vandenberg.

This TAA does NOT include Boeing or Analex Corporation's subcontractors aiSolutions Corporation and Science Applications International Corporation (SAIC). These entities will submit their own license or TAA applications as these prove to be necessary.

This TAA does NOT include work between Analex and CNES' spacecraft bus partner Alcatel for OSTM or other CNES' contractors such as Thales. That work will be covered under a separate TAA.

This TAA also does NOT include export to any other of the OSTM partners, such as EUMETSAT. Analex is NOT expecting to need to work with any other foreign partners for this mission. If the need arises, a separate TAA or license will be submitted, as required.

2. It is understood that this Technical Assistance Agreement is entered into as required under U.S. Government Regulations and as such, it is an independent agreement between the parties, the terms of which will prevail, notwithstanding any conflict or inconsistency that may be contained in other arrangements between the parties on the subject matter.

3. The parties agree to comply with all applicable sections of the International Traffic in Arms Regulations (ITAR) of the U.S. Department of State and that more particularly in accordance with such regulations the following conditions apply to this agreement:

I. ITAR Section 124.7

(1) No hardware will be manufactured or exported under this agreement.

(2) NASA has procured and will provide launch services on a Boeing Delta II launch vehicle and pre-launch engineering support. NASA and its contractors, and CNES and its contractors, and Boeing and its contractors, will jointly develop and verify Interface Control Documents or ICDs on the interface between OSTM and the launch vehicle. This includes providing Analex engineering support for ICDs, identifying and implementing mission unique requirements.

Meetings and telephone conversations/conferences will take place as necessary to maintain control of respective areas of responsibility, on an as required basis. As a general rule, no contractors will be in attendance without prior approval, on an as needed basis.

Working Groups and Reviews and Launch site activities will be on an as required basis, and parties will be invited to attend as appropriate in accordance with the ELVIS contract.

Technical interface will include ICDs, Launch Site Procedures, etc., as per the OSTM Project Plan and the list of documents at EXHIBIT 3.

No hardware will be shipped under this agreement. If it becomes necessary for Analex to ship hardware to CNES, a separate export license will be applied for.

No design or manufacturing know how or rights will be exported under this agreement.

(3) This TAA is to enter into effect on the date of the final signature and is to remain in effect until March 31, 2011.

(4) Technical data will be shared with CNES in France and with their employees in the U.S., mostly if NOT exclusively at Vandenberg Air Force Base, California and in its vicinity. Analex will deliver on-site support services to CNES' French personnel at Vandenberg or in its vicinity.

II. ITAR Section 124.8

(1) This agreement SHALL NOT enter into force, and SHALL NOT be amended or extended without the prior written approval of the Department of State of the U.S. Government.

(2) This agreement is subject to all United States laws and regulations relating to exports and to all administrative acts of the U.S. Government pursuant to such laws and regulations.

(3) The parties to this agreement agree that the obligations contained in this agreement SHALL NOT affect the performance of any obligations created by prior contracts or subcontracts which the parties may have individually or collectively with the U.S. Government.

(4) No liability will be incurred by or attributed to the U.S. Government in connection with any possible infringement of privately owned patent or proprietary rights, either domestic or foreign, by reason of the U.S. Government's approval of this agreement.

(5) The technical data or defense service exported from the United States in furtherance of this agreement and any defense article which may be produced or manufactured from such technical data or defense service may NOT be transferred to a person in a third country or to a national of a third country except as specifically authorized in this agreement unless the prior written approval of the Department of State has been obtained.

(6) All provisions in this agreement which refer to the United States Government and the Department of State will remain binding on the parties after the termination of the agreement.

ADDITIONAL TERMS

1. This authorization expires March 31, 2011.

2. Sub-licensing/retransfer is NOT authorized under this agreement.

3. The applicant will NOT export any authorized hardware, software, technical data, or defense services against this agreement until all parties have executed the agreement. In accordance with 22 CFR 124.4(a), one copy of the signed agreement, revised as may be required by the Department of State, will be submitted to Defense Trade Controls within 30 days after it enters into force. The applicant will inform Defense Trade Controls within 60 days, if a decision is made NOT to execute the approved agreement.

4. If the agreement is NOT executed within one year of the date of this approval, a written report as to the status of the agreement will be submitted to Defense Trade Controls on an annual basis until the requirements of 22 CFR 124.4 or 22 CFR 124.5 have been satisfied.

5. Export or temporary import of hardware against this agreement under the provisions of 22 CFR 123.16(b)(l) or by separate license (i.e., DSP-5 or DSP-73) is NOT authorized. Hardware shipment may take place only after the Department of State approves an amendment to the agreement.

6. The applicant SHALL NOT release detailed design data or concepts, design methodology, or manufacturing know-how for the Delta II launch vehicle, components, and ground support equipment. Technical procedures (to include the launch vehicle countdown procedure) that are launch vehicle specific are NOT authorized for release.

7. The applicant SHALL NOT provide any technical assistance to the consignee(s) who might assist the consignee(s) in the design, development; or enhancement of contemplated or existing space systems, launch facilities, or launch processes/operations.

8. All anomaly/problem resolution shall be accomplished strictly by the responsible parties. Collaborative failure analysis with foreign parties is NOT authorized. Anomaly/non-conformance/failure reports shall be limited to functional block diagrams, top-level descriptions, and drawings/schematics that do NOT reveal detailed design. Data SHALL NOT contain systems engineering processes, techniques, or methodologies.

9. Launch failure analysis or investigation is NOT authorized under this license. In case of a launch failure, discussions or transfer of any technical data shall be the subject of a separate license submitted for Department of State approval.

10. Information on U.S. Government systems, operations, limitations, or capabilities that is NOT already in the public domain SHALL NOT be offered, discussed, or released.

11. There shall be NO unmonitored or unescorted access to the launch vehicle or any controlled equipment or technical data related to the launch, unless otherwise authorized by a license. Whenever foreign nationals are present, monitoring shall be on a 24-hour basis by U.S. participants throughout launch preparations, satellite mating/demating, test and checkout, launch, and debris recovery.

12. Foreign nationals WILL NOT be granted access to other facilities, equipment, or work performed in support of the U.S. Government, or to information systems that provide access to additional technical data sources, files or technical data NOT authorized for release under this TAA.

13. The applicant shall maintain a library of released technical data subject to U.S. Government inspection and audit. The cost of DOD participation in any audit performed by the U.S. Government is reimbursable to the DOD. No NASA or CNES-provided funds will be used for reimbursement of DOD participation in any audit or meeting performed by the U.S. Government.

14. The applicant's independent analyses products or test data released will be limited to results only. The applicant may reference specifications and requirements that need to be met to ensure the safe integration of the spacecraft and launch vehicle. The applicant may point out to the foreign consignee the exact specifications and requirements that are NOT being met. However the applicant WILL NOT augment or suggest changes to the foreign consignee's processes that optimize, enhance, improve or increase the capabilities of the consignee or correct a specific deficiency. Design or technical analysis tools or methods of assessment (models, algorithms, databases or software) which are NOT in the public domain, WILL NOT be offered or released.

15. Software source code, operating algorithms and program maintenance documentations WILL NOT be discussed, offered, or released.

16. The launch service provider is NOT a signer to this agreement. If the launch service provider attempts to actively participate in technical activities between the applicant and the foreign consignee, the applicant will inform the launch service provider that they WILL NOT be allowed to participate without first obtaining its own license. The applicant WILL NOT act as an agent for the launch service provider. The applicant WILL NOT convey data or services to the foreign consignee for the launch service provider, and if so requested, the applicant will inform the launch service provider that they will need to obtain their own license.

17. Applicant will provide NASA HQ, Export Control and Interagency Liaison Division/John Hall Code ID, 300 E. Street, SW, Washington, D.C. 20546, with a copy of this Department of State approved license and signed Technical Assistance Agreement.

18. Applicant is only authorized to transfer NASA-controlled technical data and defense services as described in the TAA, and Annexes B & C, and Exhibit 3. Transfer of other NASA non-public domain technical data in support of this TAA requires prior NASA approval. Applicant will contact John Hall, for approval (phone: 202-358-2070, fax: 202-358-4080, e-mail: john.f.hall@nasa.gov).

19. Applicant will brief applicable NASA project managers/staff on the scope and limitations of access allowed by this license.

20. If a Technology Transfer Control Plan (TTCP) requirement is imposed, applicant will provide a copy of the approved TTCP to Export Control and Interagency Liaison Division/John Hall Code ID, 300 E. Street, SW, Washington, D.C. 20546.

21. Employees of CNES who are nationals of a third country (including "dual nationals"), are not authorized to receive any defense articles or services under this agreement. If transfer to a CNES employee who is a national of a third country is required, an amendment approved by the Directorate of Defense Trade Controls will be required. The amendment will need to identify the countries of origin and nationality of any of these CNES employees and prior to execution, the amendment must add language to this effect.

IN WITNESS WHEREOF, the parties hereto have caused this agreement to be executed effective as of the day and year above provided.

Catherine Clark
Corporate Secretary
Analex Export Control Official

Dated : 2/16/07

Pierre MOSKWA
Directeur du Centre Spatial de Toulouse
Centre National d'Etudes Spatiales

Dated : le 6/04/07

ANNEX A

OSTM Memorandum of Understanding (MOU)

Between NASA and CNES

MEMORANDUM OF UNDERSTANDING

AMONG

THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

AND

THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

JOINTLY

AND

THE CENTRE NATIONAL D'ETUDES SPATIALES

AND

THE EUROPEAN ORGANISATION FOR THE EXPLOITATION OF
METEOROLOGICAL SATELLITES

FOR COOPERATION IN

THE OCEAN SURFACE TOPOGRAPHY MISSION

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Preamble

The National Aeronautics and Space Administration (hereinafter referred to as "NASA") and the National Oceanic and Atmospheric Administration (hereinafter referred to as "NOAA"), both agencies of the United States Government, acting jointly as one Party to this Memorandum of Understanding (MOU), and as represented by their Administrators;

The Centre National d'Etudes Spatiales (hereinafter referred to as "CNES"), established under the provisions of the French Law 61-1382, dated December 19, 1961, setting up a national center for space research and, as represented by its President; and

The European Organisation for the Exploitation of Meteorological Satellites (hereinafter referred to as "EUMETSAT"), established by the Convention which entered into force on June 19, 1986, as amended by the Amending Protocol which entered into force on November 19, 2000, and as represented by its Director-General,

hereinafter referred to as the "Parties" to this Memorandum of Understanding,

RECALLING the cooperative effort of NASA and CNES that led to the launch of the TOPEX/Poseidon mission by an Ariane launch vehicle from the Kourou launch site in French Guiana, on August 10, 1992,

RECALLING the cooperative effort of NASA and CNES that led to the launch of the Jason mission by a Boeing Delta II launch vehicle from Vandenberg Air Force Base in California, on December 7, 2001,

RECOGNIZING that both the TOPEX/Poseidon mission and the Jason mission have demonstrated clearly that global sea surface topography measurements of unparalleled accuracy can be obtained from space; and further, that such measurements can create new opportunities for monitoring ocean phenomena and developing models to predict global climatic change,

RECOGNIZING the important contribution that the Jason mission has brought to operational activities that led EUMETSAT and NOAA to express a strong interest in participating in the program,

RECALLING the success of NASA in research and development on a variety of environmental programs and the extensive experience of NOAA in operating civilian satellites for the benefit of users of environmental data and the World Meteorological Organization (WMO),

RECALLING NOAA's performance of various domestic and international missions including observation and reporting of the state of the oceans and preparation and issuance of warnings and forecasts of atmospheric, flood, and ocean conditions to ensure protection of life and property; operation of environmental satellites and data archives for the United States; and provision of products and services to users and managers of oceanic, atmospheric, and coastal zone programs, RECALLING that the primary objective of EUMETSAT is to establish, maintain, and exploit European systems of operational meteorological satellites, taking into account as far as possible the recommendations of the WMO, and that a further objective of EUMETSAT is to contribute to the operational monitoring of the climate and the detection of global climatic changes,

TAKING INTO ACCOUNT the Enabling Resolution EUM/C/01/Res. VII on the Optional EUMETSAT Jason-2 Altimetry Programme, adopted at the 49th meeting of the EUMETSAT Council, in which the Council approved the execution, within the framework of the EUMETSAT Convention, of an Optional Jason-2 Altimetry Programme, and which tasked the Director-General with the preparation of the necessary cooperation agreements with international partners contributing to the overall Ocean Surface Topography Mission (OSTM),

TAKING INTO ACCOUNT that Declaration EUM/C/01/Decl. I on the Optional EUMETSAT Jason-2 Altimetry Programme adopted by EUMETSAT Potential Participating States on December 4-5, 2001, entered into force on June 27, 2003,

RECALLING that EUMETSAT and NOAA have enjoyed long-standing and fruitful cooperation in the field of operational Earth observation from space for meteorological purposes,

RECALLING that the CNES Board of Governors approved the program proposal (Phase B/C/D) for Jason-2/OSTM implementation on April 29, 2004,

TAKING INTO ACCOUNT the requirement for satellite ocean altimetry observations expressed by the WMO, the Global Ocean Data Assimilation Experiment (GODAE), the Global Ocean Observing System (GOOS), the Ocean Observations Program Committee (OOPC), and the Integrated Global Observing Strategy Partnership (IGOS-P),

TAKING NOTE OF the common interest of the Parties to continue using radar altimetry to study the oceans from space,

RECOGNIZING the imperative need that this measurement set be continued on an operational basis, and

HAVING IDENTIFIED a mutual interest in the conduct of OSTM,

HAVE AGREED as follows:

Article I - Purpose

The Parties each set forth in this MOU their respective responsibilities and the terms and conditions under which they have agreed to cooperate on OSTM. The Parties will use reasonable efforts to carry out their respective responsibilities in accordance with this MOU and to avoid changes that will have a negative effect on another Party with regard to scientific return, implementation approach, cost, and/or schedule, and where they cannot be avoided, to minimize these negative effects.

Article II – Definitions

As used in this MOU, the following terms will have the specified meanings:

1. "Damage" means:

    a. harm to, impairment of the health of, or death of any person;
    b. harm to, destruction or loss of, or loss of use of any property;
    c. other direct, indirect, or consequential damage.

2. "Data Products" are those resulting from processing of the Payload Instrument Data and any necessary supporting Housekeeping Data and/or ancillary data. These fall into two general categories:

    a. Near Real Time (NRT) Products, available within a few hours of acquisition by the satellite; and
    b. Offline Products, available with a delay of several days or weeks after additional processing.

3. "OSTM Ground Segment" means all elements and facilities required to operate the satellite, acquire its Telemetry, process, distribute, and archive Telemetry and Data Products.

4. "Partner" refers to NASA and to NOAA, when they are acting individually, and to CNES and to EUMETSAT.

5. "Proprietary Information" means information embodying trade secrets or comprising commercial or financial information that is privileged or confidential, excluding such information that:

    a. is in the public domain at the time of disclosure or thereafter enters the public domain without breach of the receiving Partner (or a Related Entity of the receiving Partner);
    b. is known to the receiving Partner at the time of disclosure;
    c. has been disclosed to the receiving Partner without restriction from the disclosing Partner;
    d. has been independently developed by the receiving Partner; or
    e. has become known to the receiving Partner without similar restrictions from a source other than the disclosing Partner, that source having the right to disclose.

6. "PROTEUS" is the name of the satellite platform.

7. "Related Entity" means:

    a. a contractor, subcontractor, or grant recipient of a Partner at any tier;
    b. a user or customer having a contractual link with a Partner at any tier;
    c. a contractor or subcontractor of a user or customer or grant recipient of a Partner at any tier; or

d. a scientific investigator.

The terms "contractors" and "subcontractors" include suppliers of any kind.

8. "Satellite," sometimes referred to as "Jason-2," is the satellite composing the space component of OSTM. It consists of a PROTEUS platform, a payload module, and payload instruments.

9. "Telemetry" is downlinked data comprising of:

    a. "Housekeeping Data" (measurements of spacecraft performance and health and welfare of the satellite); and
    b. "Payload Instrument Data" (raw instrument data).

10. "Validated Data" are Data Products based upon Telemetry after successful completion of the relevant product assessment and verification.

Article III - Mission Description and Participation

The objective of OSTM is to bring high-precision altimetry to a full operational status through the continuation of the TOPEX/Poseidon and Jason missions and their collection of measurements of sea surface height (SSH), significant wave height (SWH), wind speed at the ocean surface, and other parameters.

OSTM will provide Data Products to the operational and research user communities in support of:

- Marine meteorology and sea state forecasting;
- Operational oceanography;
- Seasonal forecasting;
- Climate monitoring;
- Ocean, Earth system and climate research.

CNES will provide the PROTEUS platform and payload module; NASA and CNES will jointly provide the payload instruments. CNES will provide a Poseidon-3, dual-frequency radar altimeter with its antenna and the Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) receiver package.

NASA will provide an Advanced Microwave Radiometer (AMR) with its antenna, a laser retroreflector array (LRA), and a Global Positioning System Payload (GPSP) receiver package.

NASA will provide launch services for the satellite.

CNES will provide a command and control center for the satellite, a European Earth Terminal and data processing, and archiving and distribution infrastructure for the mission.

NOAA will provide a control center for the satellite, command and data acquisition (CDA) stations, and data processing and archiving and distribution infrastructure for the mission.

EUMETSAT will provide a site and infrastructure for accommodation of the European Earth terminal to be integrated into the EUMETSAT Ground Segment infrastructure and data processing, rolling archiving and distribution infrastructure for the mission.

The Partners are to jointly establish and operate an OSTM Ground Segment. Telemetry is to be made available to the Partners and Data Products to the broader international user community through data centers and services under the responsibility of the Partners consistent with Article XII (Data Policy).

Data Products will be, at a minimum, consistent with TOPEX/Poseidon and Jason data products and will be defined in the Operational Service Specification (OSS) together with the associated services to the users.

OSTM operations are planned for 5 years. The mission operation is divided into six phases, the objectives of each being as follows:

1. Launch and Early Orbit Phase (LEOP). The satellite is launched and maneuvered into injection orbit. Satellite and instrument systems are activated and checked out.

2. Orbit Acquisition Phase. The satellite is maneuvered into its operational orbit. This phase is concurrent with the Assessment Phase.

3. Assessment Phase. This phase begins at the end of LEOP and ends when:

    a. the satellite and instrument systems are functionally certified;
    b. the satellite is in its operational orbit; and
    c. the ground system is ready to operate routinely.

4. Verification Phase. This phase overlaps the Assessment Phase and continues until the data and processing algorithms are satisfactorily calibrated and validated.

5. Initial Routine Operation Phase. This phase begins after completion of the Assessment Phase and is consistent with the 3-year mission design life.

6. Extended Routine Operation Phase. Assuming useful data are still being collected, this phase extends the mission an additional 2 years or any additional period that may be agreed by the Parties. This phase will include end-of-life activities.

In this MOU, the term "Routine Operation Phases" is used for both "Initial Routine Operation Phase" and "Extended Routine Operation Phase."

Article IV - CNES Responsibilities

To implement this MOU, CNES will use reasonable efforts to:

1. Establish, with the support of all Partners, the overall systems engineering function for OSTM;

2. Establish and maintain, with the support of the other Partners, and make available to the Partners the OSTM Project Plan, OSS, System Requirements, Operational Concept, Project Schedule, and other Project Documents, to be approved by the Partners as defined in the Project Plan, including relevant interface control documents and in-orbit assessment and verification plans;
3. Support NASA with information as required for the preparation and maintenance of the OSTM Safety Plan; provide NASA with information to verify compliance with the OSTM Safety Plan;
4. Establish a Mission Assurance Plan (MAP) for its own contribution, make it available to the other Partners, and review the MAPs of the other Partners;
5. Conduct or support, together with the other Partners as necessary, OSTM project reviews, as defined in the OSTM Project Plan;
6. Provide interface, design, fabrication, and test information and support as necessary for the other Partners to fulfill their respective responsibilities under this MOU;
7. Design, fabricate, test, calibrate, and prepare to integrate the PROTEUS platform and the payload module;
8. Design, fabricate, assemble, test, and calibrate the CNES instruments (the Poseidon-3 altimeter and the DORIS receiver package) and provide fully tested instruments to be integrated with the satellite;
9. Provide a site and infrastructure for instrument integration and testing of the fully integrated satellite;
10. Conduct, with NASA support, integration of the fully tested instruments onto the platform; perform functional tests of the satellite; transport the flight-ready satellite to the NASA designated launch site and support launch site processing and testing;
11. Provide ground support equipment and qualified personnel at appropriate sites to support payload and system integration, testing, and launch operations;
12. Upgrade the CNES Command and Control Center (CCC) and the data processing, archival, and distribution center (SSALTO);
13. Test the CNES elements of the OSTM Ground Segment, as defined in the OSTM Project Plan;
14. Provide to NASA all satellite information necessary for NASA to ensure satellite and launch vehicle compatibility, as defined in the OSTM Project Plan;
15. Conduct, with the support of other Partners, satellite, ground system, and overall system-level testing, evaluation of test results, and preparation for operations, as defined in the OSTM Project Plan;
16. Perform quality control of all products generated by CNES;
17. Operate and control the satellite from launch until handover of this responsibility to NOAA, including operations of the European Earth terminal, and support routine operations at NOAA and EUMETSAT, as defined in the OSTM Project Plan;
18. Lead and conduct, with the support of other Partners, the OSTM Assessment and Verification Phases, as defined in the OSTM Project Plan, and perform evaluation and calibration activities to verify the OSTM performance achieved on-orbit;

19. Coordinate operations from a system perspective, in all phases, throughout the OSTM lifetime;

20. Archive all Telemetry, as defined in the OSTM Project Plan consistent with Article XII (Data Policy), and perform offline monitoring of Housekeeping Data during all OSTM Phases;

21. Process and archive Offline Products and distribute them to users, as defined in the OSTM OSS consistent with Article XII (Data Policy), and archive NRT Products generated by NOAA and EUMETSAT;

22. Provide, test, and deliver to EUMETSAT a European Earth terminal, including a set of spare parts, and requirements for its accommodation and operations at a EUMETSAT-designated site;

23. Provide, test, and deliver to EUMETSAT Headquarters a fully tested NRT processing system; support integration and testing of the system at the EUMETSAT-specified location;

24. Provide, test, and deliver to NOAA a fully tested NRT processing system; support integration and testing of the system at the NOAA-specified location;

25. Provide to NOAA a satellite performance and analysis function and engineering and operation support for anomaly resolution for CNES instruments and satellite for the total life of the satellite;

26. Conduct, together with NASA, the preparation and release of relevant Research Announcements and, in coordination with EUMETSAT, the selection of European Investigators as specified in Article XI (OSTM Science Investigations and Application Demonstrations) of this MOU; and

27. Inform the Partners promptly of any technical or programmatic problems that may affect overall OSTM schedules, cost, or performance.

Article V - NASA Responsibilities

To implement this MOU, NASA will use reasonable efforts to:

1. Support CNES for the overall systems engineering function for OSTM;

2. Support, along with the other Partners, the preparation and maintenance of the OSTM Project Plan, OSS, System Requirements, Operational Concept, Project Schedule, and other Project Documents, to be approved by the Partners as defined in the Project Plan, including relevant interface control documents and in-orbit assessment and verification plans;

3. With support from CNES, establish and maintain the OSTM Safety Plan in response to NASA requirements; verify compliance with controls, procedures, testing, and policies, as defined in the OSTM Safety Plan;

4. Establish a MAP for its own contribution, make it available to the other Partners, and review the MAPs of the other Partners;

5. Conduct or support, together with the other Partners as necessary, OSTM project reviews, as defined in the OSTM Project Plan;

6. Provide interface, design, fabrication, and test information and support as necessary for the other Partners to fulfill their respective responsibilities under this MOU;
7. Design, fabricate, assemble, test, and calibrate the NASA instruments (an AMR with its antenna, an LRA, and the GPSP receiver package), and provide fully tested instruments to be integrated with the satellite;
8. Support CNES in the integration of the NASA instruments onto the Payload module and functional testing of the satellite;
9. Provide launch services compatible with the Jason-2 satellite and OSTM mission requirements; conduct, with support of other Partners, launch site processing and testing activities;
10. Provide ground support equipment and qualified personnel at appropriate sites to support payload and system integration, testing, and launch operations;
11. Provide to CNES all necessary launch vehicle information, and support CNES in the verification of the compatibility of satellite interfaces with the launch vehicle;
12. Support CNES, along with the other Partners, in ground system and overall system-level testing, evaluation of test results, and preparation for operations;
13. Support CNES checkout and operation of the satellite during LEOP, including additional Earth terminals such as the Transportable Orbital Tracking System (TOTS), to provide data tracking, and Flight Dynamic Facility Center involvement to provide CNES with improved satellite position;
14. Support, along with the other Partners, the OSTM Assessment and Verification Phases, as defined in the OSTM Project Plan, and perform evaluation and calibration activities to verify the OSTM performance achieved on-orbit;
15. Provide to NOAA and CNES engineering support for anomaly resolution for NASA instruments throughout the OSTM lifetime;
16. Conduct, together with CNES, the preparation and release of relevant Research Announcements and, in coordination with NOAA, the selection of U.S. Investigators as specified in Article XI (OSTM Science Investigations and Application Demonstrations) of this MOU; and
17. Inform the Partners promptly of any technical or programmatic problems, which may affect overall OSTM schedules, cost, or performance.

Article VI - EUMETSAT Responsibilities

To implement this MOU, EUMETSAT will use reasonable efforts to:

1. Support CNES for the overall systems engineering function for OSTM;
2. Support, along with the other Partners, the preparation and maintenance of the OSTM Project Plan, OSS, System Requirements, Operational Concept, Project Schedule, and other Project Documents, to be approved by the Partners as defined in the Project Plan, including relevant interface control documents and in-orbit assessment and verification plans;

3. Establish a MAP for its own contribution, make it available to the other Partners, and review the MAPs of the other Partners;
4. Conduct or support, together with the other Partners as necessary, OSTM project reviews, as defined in the OSTM Project Plan;
5. Provide interface, design, fabrication, and test information and support, as necessary, for the other Partners to fulfill their respective responsibilities under this MOU;
6. Provide a mission-compliant site and infrastructure for accommodation of the European Earth terminal, support its installation, testing, and on-site acceptance, and perform its integration with CNES support into EUMETSAT Ground Segment infrastructure, and maintain it throughout OSTM operations;
7. Support the installation, testing, and acceptance of a near real-time processing system at EUMETSAT Headquarters, and perform its integration into the EUMETSAT Ground Segment infrastructure with CNES support;
8. Establish and test the EUMETSAT elements of the OSTM Ground Segment with support of CNES, as defined in the OSTM Project Plan;
9. Support ground system and overall system-level integration, testing, and preparation of operations and assessment of readiness for launch and operations, as defined in the OSTM Project Plan, including training of key personnel;
10. Perform quality control of all products generated by EUMETSAT;
11. During all OSTM Phases, retrieve all Telemetry acquired at the European Earth terminal and make it available to the other Partners, as defined in the OSTM Project Plan;
12. During OSTM Assessment, Verification, and Routine Operations Phases, produce NRT Products from Telemetry acquired at the European Earth terminal and make them available to the other Partners, as defined in the OSTM Project Plan;
13. During OSTM Assessment, Verification, and Routine Operations Phases, make available the NRT Products produced at EUMETSAT and those generated and made available by NOAA, to users, as defined in the OSTM OSS and consistent with the Article XII (Data Policy);
14. Maintain an online storage of Telemetry acquired by EUMETSAT until such Telemetry is safely archived at the long term archives of CNES and NOAA; archive NRT Products generated by EUMETSAT and NOAA;
15. Support, along with the other Partners, the OSTM Assessment and Verification Phases, as defined in the OSTM Project Plan, and support evaluation and calibration activities to verify the OSTM performance achieved on orbit;
16. Provide a support service to users of NRT Products and a European focal point for offline users of wind-wave products, as defined in the OSTM OSS;
17. During all OSTM Phases, support NOAA and CNES in conducting mission operations;
18. Support the relevant Research Announcement process, and assess the relevance of investigation results to future operational services as specified in Article XI (OSTM Science Investigations and Application Demonstrations) of this MOU; and
19. Inform the Partners promptly of any technical or programmatic problems which may affect overall OSTM schedules, cost, or performance.

Article VII - NOAA Responsibilities

To implement this MOU, NOAA will use reasonable efforts to:

1. Support CNES for the overall systems engineering function for OSTM;
2. Support, along with the other Partners, the preparation and maintenance of the OSTM Project Plan, OSS, System Requirements, Operational Concept, Project Schedule, and other Project Documents, to be approved by the Partners, as defined in the Project Plan, including relevant interface control documents and in-orbit assessment and verification plans;
3. Provide NASA with required information necessary for NASA to establish and maintain the OSTM Safety Plan;
4. Establish a MAP for its own contribution, make it available to the other Partners, and review the MAPs of the other Partners;
5. Conduct or support, together with the other Partners as necessary, OSTM project reviews, as defined in the OSTM Project Plan;
6. Provide interface, design, fabrication, and test information and support as necessary to the other Partners to fulfill their respective responsibilities under this MOU;
7. Upgrade the NOAA Satellite Operations Control Center, CDA stations, and the data processing, archival, and distribution centers; integrate the OSTM-specific equipment, hardware, and real-time processing system into the NOAA infrastructure and communication system;
8. Test, with the support of NASA and CNES, the NOAA elements of the OSTM Ground Segment, as defined in the OSTM Project Plan;
9. Support the installation, testing, and acceptance of a near real time processing system at the NOAA-specified location, and perform its integration into the NOAA Ground Segment infrastructure with CNES support; procure and/or install the associated hardware as specified by CNES;
10. Archive all Telemetry, as defined in the OSTM Project Plan and consistent with Article XII (Data Policy), and perform offline monitoring of Housekeeping Data during all OSTM Phases;
11. Perform quality control of all products generated by NOAA;
12. Support ground system and overall system-level integration, testing, and preparation of operations and assessment of readiness for launch and operations, as defined in the OSTM Project Plan, including training of key personnel;
13. Support, along with the other Partners, the OSTM Assessment and Verification Phases, as defined in the OSTM Project Plan, and support evaluation and calibration activities to verify the OSTM performance achieved on orbit;
14. Support real-time mission operations before handover, and prepare for Routine Operations Phases with CNES support;
15. Operate and control the satellite after handover of this responsibility from CNES, including operation of the European Earth terminal;

16. During all OSTM Phases, acquire all Telemetry from the NOAA CDA Stations and make it available to the other Partners, as defined in the OSTM Project Plan;
17. During OSTM Assessment, Verification, and Routine Operations Phases, produce NRT Products from Telemetry acquired at the NOAA CDA Stations and make them available to the other Partners, as defined in the OSTM Project Plan;
18. During OSTM Assessment, Verification, and Routine Operations Phases, make available the NRT Products produced at NOAA and those generated and made available by EUMETSAT to users, as defined in the OSTM OSS and consistent with the Article XII (Data Policy);
19. Provide for long-term archival of OSTM Data Products and provide for access thereto, and make available the Offline Products generated by CNES to users, as defined in the OSTM OSS and consistent with the Article XII (Data Policy);
20. Support the relevant Research Announcement process, and assess the relevance of investigation results to future operational services, as specified in Article XI (OSTM Science Investigations and Application Demonstrations) of this MOU; and
21. Inform the Partners promptly of any technical or programmatic problems which may affect overall OSTM schedules, cost, or performance.

Article VIII - Program and Project Management

1. Each Partner will designate an OSTM Program and/or Project Manager responsible for fulfilling its respective responsibilities as defined in this MOU and based on mechanisms defined in the OSTM Project Plan.
2. The Partners will establish an OSTM Joint Steering Group (JSG) to provide oversight for the mission. The JSG will be comprised of up to two senior representatives from each Partner, as designated by the Partners in writing.
3. The JSG will meet at least once a year and, additionally, upon agreement of the Partners. The Partners' Program/Project Managers, Program or Mission Scientists, Project Scientists and others of their Project or Program staff, as agreed, will support these meetings.
4. The JSG will review project status, resolve conflicts as foreseen in Article XXIII (Settlement of Disputes), and provide institutional resources to ensure timely delivery of mission elements. The JSG will be cochaired by NASA and CNES during mission development, until handover of satellite operations, and by NOAA and EUMETSAT following handover of the satellite operations and control functions. Decision-making by the JSG will be made by consensus.
5. Changes that may impact other Partners in terms of OSTM cost, mission performance, schedule, and end of life of mission will require the approval of the JSG.

Article IX - Mission Reviews, Integration, and Flight Readiness

1. To implement OSTM, there will be a series of mission-level reviews, as defined in the OSTM Project Plan, to evaluate the readiness of the Space and Ground Segments to proceed to implementation, integration, test, and final launch preparation. The JSG, which serves as the steering committee for these reviews, will ensure that representatives from all

Partners, or each Partner's designees, are invited to serve on the boards of these reviews. All Partners will furnish relevant engineering and programmatic data and will participate in these reviews. The review process will be further described in the OSTM Project Plan.

2. Taking into account the results of the relevant reviews and key milestones, the Partners will jointly:

    a. make a final determination on the system's readiness for operations;
    b. make a final determination on the readiness of the satellite for integration with the launch vehicle; and.
    c. make a final determination on the overall readiness of the system for launch.

Article X – Project Plan and Operational Service Specification

1. CNES will prepare, in close coordination with the other Partners, the OSTM Project Plan. This plan will contain detailed statements as to how this cooperative project is to be carried out, including mission planning, provision of the satellite, instruments, and ground systems, description of interfaces, conduct of mission operations, and data delivery, overall delivery schedule, plan for formal and informal reviews, process and configuration control, data delivery timeline, and other such information as the Partners' Program/Project Managers deem necessary to control the project. The OSTM Project Plan will be approved by the JSG and maintained by the CNES Project Manager.
2. The Partners will establish and publish an OSTM OSS defining the OSTM standard Data Products and services that the Partners agree to make available jointly to the operational and Science user community. The OSTM OSS will be consistent with the Data Policy, approved by the JSG, and maintained by the CNES Project Manager.
3. In case of conflict between the OSTM Project Plan, OSS, or any other project document and this MOU, this MOU will prevail.

Article XI - OSTM Science Investigations and Application Demonstrations

1. Program or Mission Scientists: Each Partner will designate a Program or Mission Scientist responsible for its contribution to the joint OST Research Announcement (RA) process and related interactions with the operational user community. The designated Program or Mission Scientists will, in particular:

    a. oversee the selection of an Ocean Surface Topography Science Team (OSTST) supporting TOPEX/Poseidon, Jason, and OSTM;
    b. stimulate relevant interactions between selected OST investigators and the operational user community, including the establishment of agreed mechanisms for assessing the relevance of investigation results to future operational services; and
    c. ensure relevant scientific input and feedback from the operational community to the JSG.

2. The OSTST: The suite of activities within the OSTST will be selected through competitions (the RA process) every 4 years or at a time as mutually agreed by the Partners. The activities will include scientific investigations and innovative application

demonstration projects for OSTM. NASA, in coordination with NOAA, will select proposals to be funded by the United States, and CNES, in coordination with EUMETSAT, will select proposals expected to be funded by European funding agencies. The Partners will jointly select investigators from outside the United States and Europe. The OSTST will be a major contributor to geophysical calibration of OSTM, geophysical correction models update, and validation of data prior to release.

3. Project Scientists: NASA and CNES will designate Project Scientists to oversee the work of the OSTST and its interaction with the OSTM Project. They will be jointly responsible for the development of the scientific aspects of OSTM and for assuring that all data are effectively used across the OSTST and that the investigation results are expeditiously produced and made available. They will also be jointly responsible for coordinating science requirements, calibration and validation plans, and associated field experiments with other organizations.

Article XII - Data Policy

1. The Partners will make available to each other all Telemetry and Data Products in a timely manner and without any conditions as to the Partners' use of Telemetry and Data Products.

2. As a joint contribution to the worldwide exchange of meteorological and related data and products under the auspices of the WMO, the Partners will treat all Data Products listed in the OSTM OSS as "essential data and products," as defined in WMO Resolution 40 (Cg-XII), and will make them available as such to other users on a free and unrestricted basis.

3. The Partners will make available Payload Instrument Data and Data Products to Investigators selected through the joint RA process and ensure that OSTM Investigators provide a report to the Partners on the results of their investigations.

4. Subject to Article XIX (Exchange of Technology and Goods), algorithms developed for the purposes of processing payload instrument data into higher level data and science data products will be made available to the OSTST and, upon request, to other interested members of the scientific community for purposes of scientific calibration and validation.

5. All Telemetry and Data Products obtained from the OSTM system will be archived in appropriate data centers of the Partners, as defined in the OSTM Project Plan, and Data Products will be made available to all users. Additionally, pertinent ground-based and correlative observations made in support of Payload Instrument Data and Data Product validation will be archived and made available. Notwithstanding termination of this MOU, all Telemetry and Data Products will be archived by the Partners for at least 10 years after the termination of OSTM, unless otherwise agreed by the Partners.

6. There will be no period of exclusive use of Validated Data. The goal should be the release of Validated Data in some preliminary form at the start of the Initial Routine Operation Phase.

Article XIII – Publication of Public Information and Results

1. The Partners retain the right to release public information regarding their own activities under this MOU. The Partners will coordinate with each other in advance concerning public information activities which relate to the other Partner's responsibilities or performance under this MOU.

2. The Partners will ensure that the analyzed results obtained from the OSTM will be made available to the general scientific community through publication in appropriate journals or presentations at scientific conferences as soon as possible and consistent with good scientific practices. In the event that such reports or publications are copyrighted, the Partners will have a royalty free right under the copyright to reproduce, distribute, and use such copyrighted work for their own purposes.

Article XIV - Intellectual Property Rights

1. Nothing in this MOU will be construed as granting or implying any rights to, or interest in, patents owned or inventions which are independently developed by a Partner or a Related Entity.

2. All intellectual property conceived or developed solely by a Partner or Related Entity, in the performance of the activities of this MOU, will be owned by such Partner or a Related Entity.

3. In the event that an invention is jointly made by employees of more than one Partner and/or a Related Entity of more than one Partner during the implementation of this MOU, the Partners concerned will consult and agree as to the responsibilities and costs of actions to be taken to establish and maintain patent protection (in any country) for such invention and on the terms and conditions of any license or other rights to be exchanged or granted by or between the Partners.

Article XV – Customs/Taxes/Immigration

1. In accordance with applicable laws and regulations, each Partner will endeavor to facilitate free customs clearance and waiver of all applicable customs duties and taxes for equipment and related goods necessary for the implementation of this MOU. In the event that any customs, duties, or taxes of any kind are nonetheless levied on such equipment and related goods, such customs duties or taxes will be borne by the Partner having its headquarters in the country levying such customs, duties, or taxes. Such arrangements will be fully reciprocal.

2. Subject to applicable laws and regulations, each Partner will endeavor to facilitate provision of the appropriate entry and residence documentation for personnel of the other Partners in order to carry out the activities under this MOU.

Article XVI – Exchange of Personnel

To facilitate coordination related to the OSTM, the Partners will support the exchange of a limited number of personnel from each Partner, at a time and under conditions as mutually agreed between the Partners' Project Managers, pursuant to necessary administrative authorizations. In the event of such an exchange, the Partners will provide necessary office space and administrative support at the host location, including such additional support services as may be agreed between the Partners' Project Managers. Salary and all other expenses will be borne by the employing Partner of the personnel throughout the duration of their assignment.

Article XVII – Financial Arrangements

Each Partner will bear the costs of discharging its respective responsibilities, including travel and subsistence of personnel and transportation of all equipment and other items for which it is responsible. Further, it is understood that each Partner's obligations are subject to the availability of appropriated funds. Should any Partner encounter budgetary problems that may affect the activities to be carried out under this MOU, the Partner encountering the problems will notify and consult with the other Partners as soon as possible.

Article XVIII – Ownership of Elements and Equipment

For the purposes of this MOU, each Partner will retain ownership of elements and equipment it furnishes to another Partner, except as otherwise agreed. Any equipment not launched into space will be returned to the furnishing Partner at such time as mutually agreed, unless otherwise agreed. Each Partner will transport its equipment to the delivery points, as specified in the OSTM Project Plan, and, where appropriate, from such delivery points, when the equipment is to be returned to the furnishing Partner.

Article XIX - Exchange of Technology and Goods

The Parties will transfer only that technology (including algorithms, software, and source code) and those goods necessary to fulfill their respective responsibilities under this MOU, in accordance with the following provisions:

1. All activities of the Parties will be carried out in accordance with applicable laws and regulations, including their export control laws and regulations and those pertaining to the control of classified information.

2. The transfer of technology for the purpose of discharging the Parties' responsibilities with regard to interface, integration, and safety will normally be made without restriction, except as provided in paragraph 1 above.

3. All transfers of goods and proprietary or export-controlled technology are subject to the following provisions: In the event a Partner or its Related Entity finds it necessary to transfer goods or to transfer proprietary or export-controlled technology, for which protection is to be maintained, such goods will be specifically identified and such proprietary or export-controlled technology will be marked. The identification for goods and the marking on proprietary or export-controlled technology will indicate that the goods and proprietary or export-controlled technology will be used by the receiving Partner or its Related Entity only for the purposes of fulfilling the receiving Partner's or its Related Entity's responsibilities under this MOU, and that the identified goods and marked proprietary technology or marked export-controlled technology will not be disclosed or retransferred to any other entity without the prior

written permission of the furnishing Partner or its Related Entity. The receiving Partner or its Related Entity will abide by the terms of the notice and protect any such identified goods and marked proprietary technology or marked export-controlled technology from unauthorized use and disclosure. The Partners to this MOU will cause their Related Entities to be bound by the provisions of this Article related to use, disclosure, and retransfer of goods and marked technology through contractual mechanisms or equivalent measures.

4. All goods exchanged in the performance of this MOU will be used by the receiving Partner or its Related Entity exclusively for the purposes of the MOU. Upon completion of the activities under the MOU, the receiving Partner or its Related Entity will return or, at the request of the furnishing Partner or its Related Entity, destroy, or otherwise dispose of, as mutually agreed, all goods and marked proprietary technology or marked export-controlled technology provided under this MOU.

Article XX - Liability

1. The Parties agree that a comprehensive cross-waiver of liability will enhance participation in space exploration, use, and investment. The cross-waiver of liability will be broadly construed to achieve this objective. The terms of the waiver are set out below.

2. As used in this Article:

   a. "Launch Vehicle" means an object or any part thereof intended for launch, launched from Earth, or returning to Earth which carries payloads;

   b. "Payload" means all property to be flown or used on or in a launch vehicle; and

   c. "Protected Space Operations" means all activities pursuant to this MOU, including launch vehicle activities and payload activities on Earth, in outer space, or in transit between Earth and outer space. Protected Space Operations begin at the entry into force of this MOU and end when all activities done in implementation of this MOU are completed. It includes, but is not limited to:

      (i) research, design, development, test, manufacture, assembly, integration, operation, disposal or use of launch or transfer vehicles, payloads, or instruments, as well as related support equipment and facilities and services; and
      (ii) all activities related to ground support, test, training, simulation, or guidance and control equipment and related facilities or services.

   Protected Space Operations excludes activities on Earth that are conducted on return from space to develop further a payload's product or process for use other than for the joint activity in question.

3.

   a. Each Party agrees to a cross-waiver of liability pursuant to which each Party waives all claims against any of the entities or persons listed in subparagraphs (i) through (iii) below based on Damage arising out of Protected Space Operations. This cross-waiver of liability will apply only if the person, entity, or property causing the Damage is involved in Protected Space Operations and the person, entity, or property damaged is damaged by virtue of its involvement in Protected Space Operations. The cross-waiver of liability will apply to any claims for Damage, whatever the legal basis for such claims, including but not limited to delict and tort (including negligence of every degree and kind) and contract, against:

(i) another Party;
(ii) a Partner or a Related Entity of a Partner; and
(iii) the employees of any of the entities identified in subparagraphs (i) and (ii) immediately above.

b. In addition, each Partner will extend the cross-waiver of liability, as set forth in subparagraph 3.a above, to its Related Entities by requiring them, by contract or otherwise, to agree to waive all claims against the entities or persons identified in subparagraphs 3.a (i) through 3.a (iii) above.

c. Notwithstanding the other provisions of this Article, this cross-waiver of liability will not be applicable to:

(i) claims between a Partner and its own Related Entity or between its own Related Entities;
(ii) claims made by a natural person, his/her estate, survivors, or subrogees for bodily injury, other impairment of health or death of such natural person, except where the subrogee is a Partner;
(iii) claims for Damage caused by willful misconduct;
(iv) intellectual property claims;
(v) claims for Damage resulting from a failure of a Partner to extend the cross-waiver of liability, as set forth in subparagraph 3.b, or from a failure of a Partner to ensure that its Related Entities extend the cross-waiver of liability as set forth in subparagraph 3.b; or
(vi) contract claims between the Partners based on the explicit contractual provisions.

d. Nothing in this Article will be construed to create the basis for a claim or suit where none would otherwise exist.

e. For avoidance of doubt, this cross-waiver of liability includes a cross-waiver of liability arising from the Convention on International Liability for Damage Caused by Space Objects of March 29, 1972, where the person, entity, or property causing the Damage is involved in Protected Space Operations and the person, entity, or property is damaged by virtue of its involvement in Protected Space Operations.

4. In the event of third-party claims for which any of the Partners may be liable, the Partners will consult promptly to determine an appropriate and equitable apportionment of any potential liability and on the defense of any such claims.

5. NASA and NOAA, jointly, and CNES, have requested their respective governments to conclude an agreement that includes a cross-waiver of liability between their respective governments. All rights and obligations under this MOU related to the responsibility to launch as provided by paragraph 9 of Article V (NASA Responsibilities), will be contingent upon the conclusion between France and the United States of such an agreement.

Article XXI - Registration of Satellite and Frequencies

1. CNES will perform all the procedures enabling the Government of France to register the Jason-2 satellite as a space object in accordance with the Convention on Registration of Space Objects Launched into Outer Space of January 14, 1975. Registration pursuant to this Article will not affect the rights or obligations of the Parties under the 1972 Convention on International Liability for Damage Caused by Space Objects.

2. CNES will also take the necessary steps to ensure registration of the Jason-2 satellite frequencies by the International Telecommunication Union (ITU), with the support of the other Parties as required.

Article XXII – Provision for Future Cooperation

The Partners will consider working together, as appropriate, on a long-term basis to help define the research and operational requirements for implementation of future ocean surface topography missions involving Europe and the United States, with the objective of ensuring fitness for purposes of research and continuity of data and services for all applications.

In the event a mission failure unexpectedly terminates the OSTM prior to its planned end of lifetime, the Partners agree to consult regarding the resulting gaps in data collection.

Article XXIII - Settlement of Disputes

Disputes relating to this MOU will be resolved exclusively by the Parties.

Any dispute in the interpretation or implementation of the terms of this MOU that is not resolved by the Project and Program Managers will be referred to the JSG for settlement. Should the JSG be unable to resolve the dispute, it will be submitted to the representatives of each Partner as mentioned in the Preamble of this MOU, or their designees, for an amicable resolution.

Article XXIV - Entry into Force, Duration, Amendment, and Termination

1. This MOU will enter into force upon signature by all Parties. It will remain in force until completion of the Extended Routine Operation Phase. This MOU may be amended and extended by written agreement of the Parties. Any Party may terminate its participation in this MOU at any time upon at least 12 months written notice to the other Parties. In that event, the terminating Party will consult with the other Parties and will endeavor to minimize negative impacts of such termination on the other Parties and the mission.

2. Termination or expiration of this MOU will not affect the Parties' continuing obligations under Articles XII (Data Policy), XIII (Publication of Public Information and Results), XIV (Intellectual Property Rights), XIX (Exchange of Technology and Goods), and XX (Liability) of this MOU.

Done, in four originals, in the English and French languages, both language versions being equally authentic.

Signed at: Washington, DC

Date: March 21, 2006

FOR THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Signed at: WASH. D.C.

Date: 3/24/06

FOR THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Signed at: PARIS, April 7th, 2006

Date:

FOR THE CENTRE NATIONAL D'ETUDES SPATIALES

Signed at: Darmstadt

Date: 30/3/6

FOR THE EUROPEAN ORGANISATION FOR THE EXPLOITATION OF METEOROLOGICAL SATELLITES

ANNEX B

CNES/NASA OSTM Project Plan

Ref. :	TP3-J0-GP-104-CNES			
Issue :	1	Date :	Sep 1, 2005	
Revision :	2	Date :	Feb 9, 2006	

OSTM/Jason-2

DIRECTION CENTRE SPATIAL DE TOULOUSE

SOUS-DIRECTION : PROJETS ORBITAUX

SERVICE : ALTIMÉTRIE

OSTM/JASON-2 PROJECT PLAN

	Date	Signature
Prepared by : CNES with contributions from EUMETSAT, NASA/JPL, NOAA		
Approved by : CNES J. Perbos EUMETSAT F. Parisot NASA/JPL P. Vaze NOAA W. Bannoura		
For application : CNES OSTM/Jason-2 JSG EUMETSAT OSTM/Jason-2 JSG NASA/JPL OSTM/Jason-2 JSG NOAA OSTM/Jason-2 JSG		

Configuration-managed Document	YES/NO		By : CCB
Document status :			

CENTRE NATIONAL D'ÉTUDES SPATIALES

Siège
2, place Maurice Quentin - 75039 Paris Cedex 01
Tél. : 01 44 76 75 00 / Téléfax 01 44 76 76 76 / Télex 214674
SIRET 775 665 912 00082

Centre de Toulouse
18, avenue Edouard Belin - 31401 Toulouse Cedex 9
Tél. : 05 61 27 31 31 / Téléfax : 05 61 27 31 79 / Télex 531081
SIRET 775 665 912 00033

RCS PARIS B 775 665 912 - CODE APE 731Z - N° d'identification TVA : FR 49 775 665 912

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1. INTRODUCTION

1.1 BACKGROUND AND SCOPE

In December 1996, the Centre National d'Etudes Spatiales (CNES) in France and the National Aeronautics and Space Administration (NASA) in the United States formally agreed in a Memorandum of Understanding (MOU) to jointly participate in the Jason-1 mission to design, build, deploy, and operate a satellite to continue the collection of sea-surface elevation measurements originally begun by the TOPEX/Poseidon (T/P) mission. The TOPEX/Poseidon mission, which was launched in August 1992, was the first such mission in a world-wide effort to study and describe global ocean dynamics and its relationship to the Earth's environment and climate change. The unprecedented success of TOPEX/Poseidon led mission planner to recognize the need to sustain the high accuracy measurements of sea surface elevation in order to integrate this information into climatic models for long term climate prediction.

Jason-1 was successfully launched in December 2001, and since then is delivering geophysical data at a level of performance identical to TOPEX/Poseidon (T/P). Jason-1 is noticeably different from T/P in that the measurements are no longer experimental in nature, near-real time products derived from the altimetric measurements are being disseminated on a routine basis.

To continue the observations made by T/P and Jason-1 and provide a transition into operational altimetry missions in the future, NASA, CNES with NOAA and EUMETSAT have decided to launch a JASON-1follow-on mission, the Ocean Surface Topography Mission (OSTM)/Jason-2 mission. The Jason-2 satellite will carry similar instruments to Jason-1 as its baseline payload, and fly in the same orbit as Jason-1. The primary mission objective is to continue the T/P/Jason-1 measurements with the same performance. The availability of a continued data stream from altimetric measurements with near real-time access has resulted in the participation in this mission of NOAA and EUMETSAT agencies interested in the operational applications of these data. The Jason-2 satellite is planned to be launched in 2008.

In accordance with the MOU between CNES, EUMETSAT, NASA and NOAA, hereafter referenced as “the partners”, the Project Plan defines the means by which NASA and NOAA in the U.S., and EUMETSAT and CNES in Europe shall jointly act in cooperation to execute the OSTM/Jason-2 mission.

The Project Plan is a mutual CNES / EUMETSAT / NASA / NOAA plan for developing the systems which support the space, launch, ground, and science segments for the OSTM/Jason-2 Mission. This plan defines how this cooperative project will be implemented, including:

- mission management (responsibilities, reviews, configuration control, documentation, actions management, confidentiality, schedule management),
- reciprocal products deliveries and management of their interfaces (launcher, satellite, payload, instruments, ground systems),
- mission operations (responsibilities, data deliveries),
- and other such information as the Project Managers deem necessary for project control.

The Project Plan document applies on the same time period as the MOU i.e on the entire mission life as defined in the MOU. If needed, modifications will be introduced in the document to better cover the transition from development to operation and the routine operation phases.

Section 1 of this document provides general information and recalls the Science and Programmatic background of the project.

Section 2 of this document lists the highest level requirements and constraints placed upon the project.

Section 3 describes the mission overall organization, the management responsibilities at program, science and project level. It also recalls the division of responsibilities between the four partners.

Section 4 describes the Mission Assurance processes, including Safety aspects, and Risk Management approach.

Section 5 describes briefly the flight system elements as they will be delivered by each participating agency and according to the division of responsibilities given in section 3. Responsibilities of each agency during the development, assembly integration and test , and launch campaign phases are addressed. This section describes the ground system architecture and the concept which will be applied for satellite operation, the way it will be conducted according to the different phases and the responsibility of each agency. Then the data processing scheme, the definition of the data products, the way they will be processed and what shall be exchanged between the agencies to this purpose is presented. Finally, the verification activities are described in this section.

Section 6 describes the system level documentation along with the agency responsible for the document's preparation and the agencies with authority to approve each of the listed documents.

Section 7 briefly describes the configuration management principles and rules that will be formally applied in case of modifications of document affecting the mission requirements and /or interfaces between the system elements.

Section 8 addresses the major reviews conducted at program and project level and which shall periodically assess the progress of the project.

Section 9 describes the way the master project (Level 1) schedule and lower level schedules are built and controlled.

Section 10 describes the Project reporting rules and management processes, including action item management, and project teams interaction.

Finally section 11 addresses the management of hardware and software deliveries between two or more of the project partners

1.2 MISSION SCIENCE OBJECTIVES

The main objectives of Jason-2/OSTM include the continuation of the T/P and Jason-1 missions, based on the science and pre-operational returns of these two missions, and the support in a timely manner to the global and regional operational applications.

1.2.1 RESEARCH TOPICS COVER MANY DIFFERENT FIELDS :

Description of the mean ocean circulation using altimetric sea level measurements is essential to better understand its interaction with the time-varying components and the involved mechanisms. It is also important for initializing ocean models. The large accumulation of altimetric data from the early missions through Jason-2/OSTM and follow-on, along with high resolution marine geoid derived from space-borne gravimetric measurements (CHAMP in 2000, GRACE in 2002, GOCE in 2005) will provide significant contributions to a better understanding of this "mean" ocean.

The ocean exhibits variability at different scales in time and space, affecting significantly mass and heat transport, exchanges with the atmosphere, and consequently the climate. Sea surface topography as measured by altimetry has proven its usefulness to understand the physics behind this variability. Model parameterization has been improved thanks to these new findings. But there is still more to do. Apart from the seasonal cycle, which leads to an increase or decrease in sea level in each hemisphere, exceeding 15 cm in some areas, there are significant variations from one year to the next which are not yet well understood. The El Nino event, the North Atlantic Oscillation, the Pacific Decadal Oscillation, the planetary waves crossing the oceans over periods of months to years and even decades are among the mechanisms which need to be better characterized.

Because of the long period of these phenomena, very long time series of altimetric observations are needed, requiring Jason-2/OSTM and follow-on missions.

Mesoscale ocean variability is associated with shorter time and space scales (typically 1 month/30-100 km) but it impacts significantly the energy balance within the ocean and between the ocean and the atmosphere. Western boundary turbulent currents and the energetic whirlpools which they form, play an essential role in moving heat from low to high latitudes. But eddies are traveling over all the oceans interacting with the lower frequency modes as well as with the coastal currents, coast line, continental shelf, and bathymetry. This eddy activity is now quite well characterized statistically, thanks to the multi-year accumulation of altimetric data. But we need to go one step further to decode this complicated turbulent physics and to transcribe it better in the eddy resolving open ocean and coastal models. Jason-2/OSTM (as Jason-1 and T/P) will provide spatial resolution not optimized for such investigations (320 km at the equator), but its contribution along with complementary missions (e.g. ENVISAT and follow-on) will be essential.

At the other end of the ocean variability spectrum, the secular mean sea level trend is a pertinent indicator of global warming. The unique accuracy of T/P sea level measurements has demonstrated an unexpected capability of recovering a global trend of about 2 mm/year. Nevertheless, this parameter has an extremely small variation, at the limit of what can be observed even with systems as efficient and accurate as T/P and Jason-1. Only long term time series over several decades will decrease the error bar at a level consistent with the small amplitude of the signal. The continuation of Jason type missions is a unique way to fulfill this objective of great importance and of general interest.

In the domain of tide modeling significant progress has been made thanks to the altimetry, in particular T/P data. Several models now are able to predict the main diurnal and semi-diurnal components of ocean tides with an exceptional precision of 2 cm rms. But investigations are continuing to track more subtle tide signals, including long period components, coastal interactions, internal waves generated by the tides, and tidal energy dissipation. All these issues need the continuation of altimetric missions, including Jason-2/OSTM, to provide the appropriate space and time sampling of the sea level.

Other domains will benefit from the Jason-2/OSTM mission. Estimates of wave height and wind speed derived from the radar altimeter echoes are two parameters which are of great value for marine meteorology and climatology studies as well as operational sea-state forecasts investigations in the field of earth sciences, such as research on marine geoid, tectonics, hydrology, ice, closed seas, great lakes, and desert regions, will also greatly profit from the continuation and the merging of high precision Jason-2/OSTM altimetric measurements with other data sets.

1.2.2 OPERATIONAL APPLICATIONS, PREDICTING THE OCEAN WEATHER:

One of the major objective of the Jason-2/OSTM mission will be to support the transition from the ocean operational system demonstration phase (the 2003-2006 GODAE time frame) to the ocean routine operations. Operational activities can be divided into two categories depending on the time-scale : the short range ocean forecast (in which we can include coastal aspects) and the seasonal to long term range ocean forecast.

1.2.2.1 SEASONAL OCEAN FORECASTING

The seasonal ocean forecasting is one of the most demanding and ambitious objectives. Information on these time scales provided by altimetry to the ocean models is essential, because the role of currents is not yet well understood and well parameterized. Even if progress in the related physics is expected within the next years, the near-real time ocean state estimates derived from altimetric data and assimilated continuously with other data sets, into models is of great value. This assimilation leads to a description and a prediction of oceanic currents, temperatures, and salinity with a level of precision that has never before been obtained. The question of longer term predictions (interannual to decadal) is of importance, but research in this field is just starting, so long term routine ocean forecasts will not emerge in the near future. As mentioned previously, long time series of accurate altimetric data (Jason-2/OSTM and follow-on) will help in understanding this ocean long-period variability and its interaction with short term modes (participating thus in the improvement of seasonal forecasts).

One example of seasonal ocean forecast operated on a routine basis is the one provided by NOAA. Since 1996, T/P sea level anomalies have been assimilated each week in the National Centers for Environmental Prediction (NCEP) Pacific Ocean model used to predict El Nino and Southern Oscillation (ENSO). This processing is done in near-real time thanks to the 2-day latency delivery of T/P interim geophysical data. In the mean time several groups around the world are working on the coupling of ocean with atmosphere to develop seasonal climate forecasting models. Such models will use as inputs the ocean analysis and predictions released by ocean operational centers.

1.2.2.2 SHORT RANGE OCEAN PREDICTION

The short range ocean prediction has many applications of great interest. Several global and regional models have been developed and run in an experimental or pre-operational configuration, before entering the operational phase (e.g. MERCATOR, FOAM, ECCO...). They provide high resolution, high frequency 3D products which depict and forecast a few weeks in advance the very short scale nature of the ocean signal, including current positions and intensity, position and scales of eddies and thermal fronts. One issue which is especially challenging is understanding the connection of the open ocean with the coastal ocean and development of models capable of recovering the sharpest details. Because of the highly turbulent characteristics of this short range signal and its non-linear evolution, it is necessary to take advantage of global, dense, and accurate observations. Altimetry is especially powerful for monitoring in near-real time the mesoscale signal and adjusting regularly the models. The derived products satisfy many applications (e.g. marine safety, marine pollution, ship routing, navy needs, oil drilling, coastal forecasts, fish stock management...).

For instance, based on these products, links can be observed between the marine environment, the rate of marine species reproduction, and their life cycle. Consequently, this is helpful to better manage variations in fishing resources according to fishing campaigns. Fishing industry management is a promising market for short range mesoscale products (e.g. CLS CATSAT project, NOAA fishery service forecasts). The offshore drilling oil industry is also interested in those products because petroleum companies are going further from the coast and into deep water. Oil is brought to the surface through flexible umbilicals to barges anchored above the site, and tankers then remove the oil from these barges. Knowing the currents at the surface but also at a depth of several hundred meters is very useful for this type of operation sensitive to destructive eddies and fronts. Navy forces need also for their own needs specific forecasting and analysis of short range oceanic state. Water masses, temperatures, currents, eddies, and the position of fronts are essential information to help both surface and underwater navigation.

Another field of activity is that concerning coastal areas where there are many problems related to risk prevention and coastal development. High resolution models require as an input high accuracy products in the coastal band as well as at the deep ocean boundary. One example is the prediction of storm surges. They generate an abnormal increase in sea level (up to few meters) caused by low pressure together with high winds blowing from the sea toward land (amplified during hurricane situations) which can be particularly devastating to the shoreline. Another example is the trajectory monitoring and forecasting of drifting polluted waters, ships, and objects lost at sea. The drift is a result of the combined actions of currents pushed by the wind, tide, and coastal currents and large-scale oceanic circulation. Its forecast is based on dedicated oceanic models coupled with models describing the behavior and changes of the drifting materials. In this domain too, altimetry products have a key role to assess and to constrain frequently the models, improving thus the forecasts.

Meteorological centers run sea state forecast models to anticipate the evolution of waves and swells, which are superimposed, on all parts of the Earth, providing sailors and workers at sea with regular forecasts and special weather updates when weather conditions deteriorate. Such models (e.g. VAG at Météo-France, WAM at the ECMWF European Center) benefit greatly from real-time wave-height and wind speed altimetry products such as those issued within 3 hours from ERS2, Jason-1, and ENVISAT.

1.3 DEVELOPMENT, TEST AND MISSION PHASES

1.3.1 DEVELOPMENT AND TEST PHASES

1.3.1.1 SATELLITE AND INSTRUMENTS DEVELOPMENT AND TEST PHASES

The Jason-2 satellite is the fourth satellite using the PROTEUS platform, minisatellite family developed in the frame of a CNES / ALCATEL partnership programme, qualified through the Jason-1 mission and upgraded since CALIPSO.

The payload and satellite schedule do not follow the standard development scheme of a non recurrent satellite: this is due to the use of a generic platform, already qualified in flight, and the instruments integration in a Payload Integration Module (PIM) recurrent from Jason-1. For OSTM/Jason-2, there were neither specific System nor Satellite Phase A , the reason being the very strong heritage from the Jason-1 system and satellite definition.

The satellite phase B is essentially dedicated to assess the global definition of the satellite in terms of platform budgets and payload configuration and accommodation. A satellite Preliminary Definition Review (PDR) concludes this phase.

The satellite phases C and D are the classical phases which allow to fabricate , integrate and test the whole satellite.

Satellite phase C begins after the satellite PDR and ends before the integration and test phases with a satellite Critical Design Review (CDR)

Satellite phase D begins after the satellite CDR and ends when the satellite is ready to be shipped to the launch facilities. A Satellite Qualification Review (RQS) concludes this phase.

Satellite phase D includes the “Assembly, Integration and Test” (AIT) phases :

- payload AIT
- satellite AIT

Instruments have classical B/C/D phase definition. Instruments have to be available before the payload AIT phase.

The PIM has also to be available before payload integration.

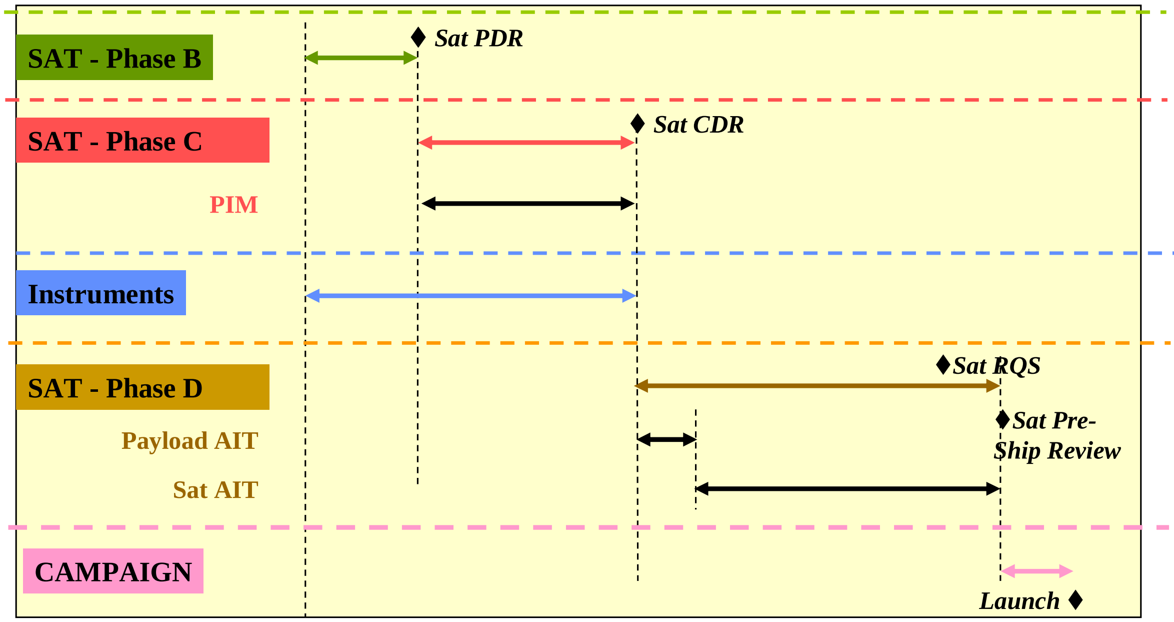
The payload AIT phase can begin when the platform, the PIM, the on-board software and at least one instrument are available. It ends when the payload is integrated and tested on the satellite.

The satellite AIT phase can begin when the payload AIT is finished and ends when the satellite is ready to be shipped to the launch facilities (end of phase D).

Before shipping the satellite to the launch facilities a Pre-ship Review takes place. The last phase before launch is the Launch campaign. This phase begins after the Pre-ship Review and ends with the satellite launch.

Reviews are described in Section 8.

The time frames for the phases are given in the OSTM/ JASON-2 SYSTEM MASTER SCHEDULE (AD16)



1.3.1.2 GROUND QUALIFICATION PHASES

Each ground element has to be developed or adapted by the element provider according to the responsibilities sharing defined in the OSTM/Jason-2 Memorandum Of Understanding (MOU). In these development phases each partner will have its own reviews. Classical acceptance meetings conclude each development phase.

As soon as several ground elements have been accepted the qualification phases can begin.

The Ground Qualifications Phases include :

The Technical Integration (IT) Phase begins with the first internal integration of NOAA or EUM or CNES housekeeping elements and ends when the NOAA and EUM and CNES housekeeping systems have been separately integrated. These integrations are managed independently.

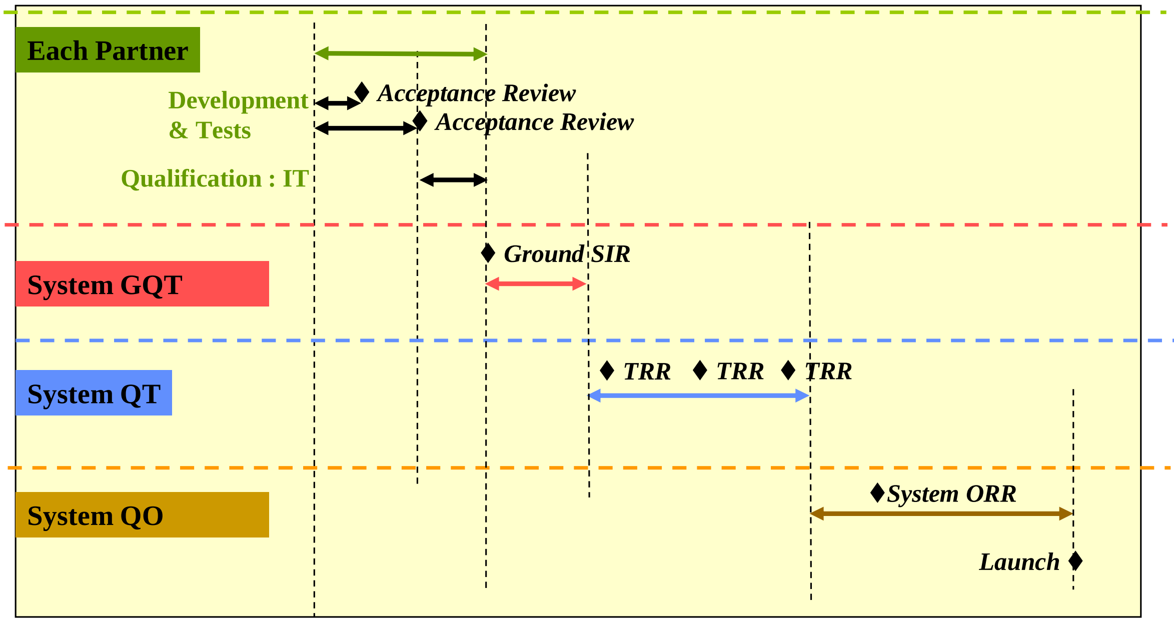
The Ground Technical Qualification (GQT) Phase begins with the first compatibility test between NOAA, EUM, CNES housekeeping elements. This phase allows to check the OSTM/Jason-2 Ground System (J2GS) interfaces (content structure, connections, transfer protocol, exchanges directories). Before this phase the "Ground System Interface Review" (SIR) will take place to verify the definition of all the ground interfaces and the readiness of each partner ground segment.

The Technical Qualification (QT) Phase begins when the main housekeeping elements of NOAA, EUM and CNES have passed the IT phase and the compatibility tests from the GQT phase . It consists in integrating together the NOAA, EUM and CNES elements, in checking that all the ground functions are performed and ends when the J2GS is technically qualified. This phase is performed without taking into account the operational constraints (like waiting for passes, …). Test Readiness Meetings (TRR) will take place before the QT phase and before each main test included in this phase

The Operational Qualification (QO) Phase can overlap the Technical Qualification Phase in time, beginning when the operations personnel will be trained in how to operate the computers and software of the J2GS and ending when mission operations personnel will demonstrate readiness to perform the mission. This phase includes an Operational Readiness Review (ORR).

Reviews are described in Section 8.

The time frames for the phases are given in the OSTM/ JASON-2 SYSTEM MASTER SCHEDULE (AD16)



1.3.2 MISSION PHASES

The OSTM/Jason-2 mission is conveniently divided into six phases, the objectives of each being as follows:

1. ***Launch and Early Orbit Phase (LEOP).*** The satellite is launched and maneuvered into injection orbit. Satellite and instrument systems are activated and checked out. The nominal duration of this phase is 3 days.

2. ***Orbit Acquisition Phase.*** The satellite is maneuvered into its operational orbit. This phase is concurrent with the Assessment Phase. The duration of this phase is about one month.

3. ***Assessment Phase.*** This phase begins at the end of LEOP and ends when:

   a. the satellite and instrument systems are functionally certified;

   b. the satellite is in its operational orbit; and

   c. the ground system is ready to operate routinely.

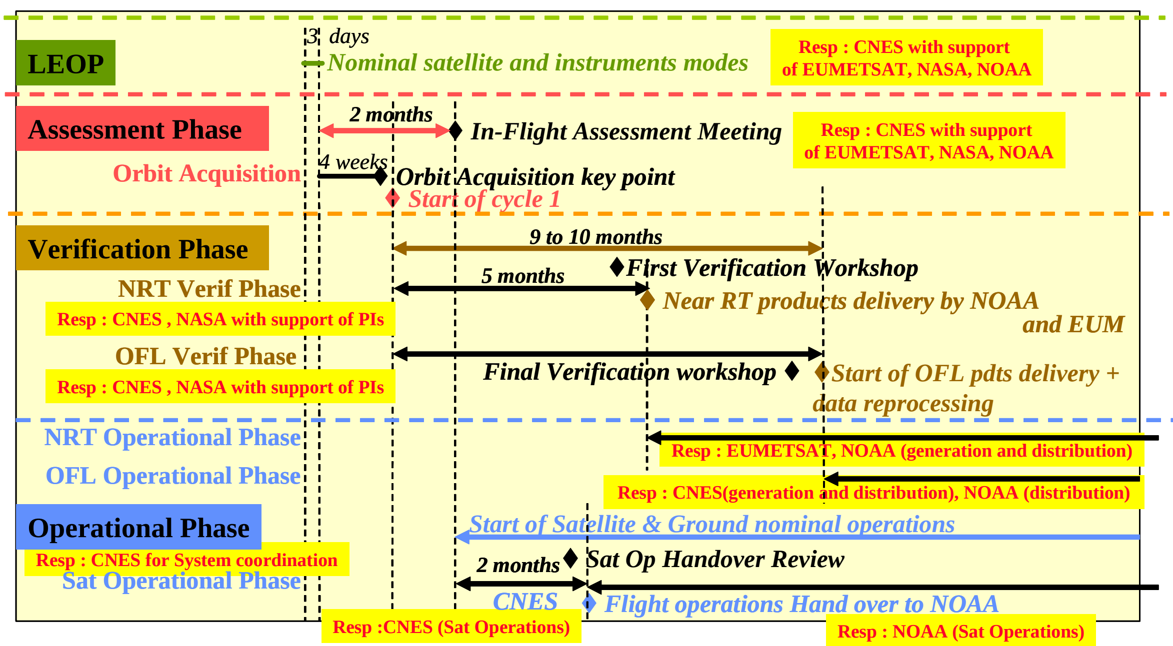
The duration of the assessment phase is 2 months.

4. ***Verification Phase.*** This phase overlaps the Assessment Phase in time, beginning when Jason-2 has reached its operational orbit (and is flying in tandem with Jason-1) , and continuing until the data received from the satellite, the instruments and the processing algorithms are satisfactorily calibrated and validated. During this phase, in situ data and laser ranging data will be collected from the verification site to be used in the

verification process. The duration and the activities of this phase greatly depend upon the availability or not of Jason-1 data at this date. A first verification workshop will be held 5 months after the beginning of the Verification Phase in order to assess the validation of the Near Real Time (NRT) products and to authorize the delivery of these products to the users. A final verification workshop will be held at the end of the Verification Phase (typically 4 months after the first workshop) in order to assess the validation of the Offline (OFL) products and authorize their release to the users. During the verification phase and before the workshop(s), data are distributed according to the decisions of the 4 partner Operational Coordination Group (to the Principal Investigators (PI's) or the Ocean Surface Topography Science Team (OSTST) members only).

5. **Initial Routine Operation Phase**. This phase begins after completion of the Assessment Phase and ends three years after launch. Instruments data are collected and monitored continuously. Science data products from the verification phase are reprocessed at the end of the Verification Phase using verified and calibrated algorithms.

6. **Extended Routine Operation Phase.** Assuming useful data are still being collected, this phase extends the mission an additional two years or any additional period that may be agreed by the OSTM/Jason-2 Partners. This phase will include end of life activities.



1.4 REFERENCE AND APPLICABLE DOCUMENTS

The OSTM/Jason-2 MOU (noted above) is the overarching document to which this Project Plan is responsive and is the authority to prevail should there occur conflicts within or with the interpretation of this document.

As separate documents will be issued to define in detail some of the topics addressed in this Project Plan, they will be considered as "applicable documents" and they will be called in the appropriate section of this Project Plan. These documents are shown in the Tables below.

1.4.1 REFERENCE DOCUMENTS

Index	Reference	Title of document
RD1		*OSTM/Jason-2 MOU : Memorandum Of Understanding among the "NASA" and the "NOAA", jointly and the "CNES" and the "EUMETSAT" for Cooperation in the Ocean Surface Topography Mission*
RD2		*Cooperation Agreement between the "EUMETSAT" and the "CNES" concerning the European Contribution to the Ocean Surface Topography Mission*

1.4.2 APPLICABLE DOCUMENTS

Index	Reference	Title of document
AD1	TP3-J0-STB-116-CNES	*OSTM/JASON-2 OPERATIONAL SERVICE SPECIFICATION*
AD2	TP3-J0-STB-44-CNES	*OSTM/JASON-2 SYSTEM REQUIREMENTS*
AD3	TP3-CUSP-20-CNES	*JASON-2 Payload Instruments Deliverables Item List*
AD4	TP3-JS-STB-110-CNES	*OSTM/JASON-2 GROUND SYSTEM REQUIREMENTS, ARCHITECTURE AND OPERATIONS CONCEPTS*
AD5	TP3-J0-NT-220-CNES	*OSTM/JASON-2: CNES/EUMETSAT Deliverables Item List*
AD6	TP3-J0-NT-221-CNES	*OSTMJASON-2: CNES/NOAA Deliverables Item List*
AD7	TP3-J0-STB-197-CNES	*OSTM/JASON-2 System Test requirements*
AD8	TP3-LB-SP-33-CNES	*JASON-2 Satellite Integration and Test Organization*
AD9	TP3-J0-PL-222-CNES	*OSTM/JASON-2 CAL/VAL plan*
AD10	TP3-J0-SP-188-CNES	*OSTM/JASON-2 SCIENCE AND OPERATIONAL REQUIREMENTS*
AD11		*JASON-2 SAFETY PLAN*
AD12		*OSTMJASON-2: NASA/NOAA Deliverables Item List*
AD13	TP3-J0-NT-87-CNES	*OSTM/JASON-2 ENGLISH/FRENCH GLOSSARY OF TERMS AND ACRONYMS*
AD14	TP3-J0-AQ-139-CNES	*OSTM/JASON-2 4 PARTNER MISSION ASSURANCE POLICY*

Index	Reference	Title of document
AD15	TP3-J0-GP-214-CNES	*OSTM/JASON-2 4 PARTNER CONFIGURATION MANAGEMENT POLICY*
AD16	TP3-J0-PL-133-CNES	*OSTM/ JASON-2 SYSTEM MASTER SCHEDULE*
AD17	TP3-J0-NT-187-CNES	*OSTM/JASON-2 MISSION ANALYSIS*
AD18	TP3-J0-GP-103-CNES	*OSTM/JASON-2 4 PARTNER DOCUMENTATION TREE*
AD19	TP3-LB-SP-21-CNES	*JASON-2 SATELLITE REQUIREMENTS*
AD20	TP3-CU-SP-32-CNES	*JASON-2 PAYLOAD INTEGRATION AND TEST REQUIREMENTS*
AD21	TP3-JS-IF-200-CNES	*OSTM/JASON-2 GROUND SYSTEM INTERFACES*
AD22		*JASON-2 SAFETY ANALYSIS*
AD23		*JASON-2 MISSION SPECIFICATION (BOEING MISSION SPECIFICATION)*
AD24		*JASON-2 SPACECRAFT QUESTIONNAIRE*
AD25		*LAUNCH SITE SUPPORT REQUIREMENTS AND LIST*
AD26		*LAUNCH SITE OPERATION PLAN*

1.5 TERMINOLOGY AND ABBREVIATIONS

See OSTM/Jason-2 acronyms document (AD13)

2. OSTM/JASON-2 PROJECT CONSTRAINTS AND LEVEL 1 REQUIREMENTS

The following requirements/constraints are applied to the OSTM/Jason-2 project:

1. The Memorandum Of Understanding co-signed by CNES, EUMETSAT, NASA and NOAA defining the general responsibilities of the partners and the terms and conditions under which they have agreed to cooperate in OSTM/Jason-2.
2. The use of the generic PROTEUS platform as the satellite platform with minimized adaptations.
3. The development of a new set of instruments, with obviously a large heritage from Jason-1 but also with the aims to reduce mass and/or power consumption, to increase availability and ease the operations.
4. The use of a US launch vehicle compatible of the PROTEUS platform.
5. The use of the PROTEUS generic ground segment (Control Center and one Earth Terminal) adapted to OSTM/Jason-2.
6. The use of the multi mission center “Segment Sol Multimission Altimétrie et Orbitographie“ (SSALTO) already operating for Jason-1, Topex/Poseidon, DORIS /SPOT, DORIS/ Envisat and Envisat altimeter data processing and distribution, as CNES mission center.
7. The re-use of the NASA Jason-1 ground system (JTCCS) as a baseline for developing the OSTM/Jason-2 ground system for the Satellite Operation Control Center (SOCC) at NOAA
8. The launch date set around June, 2008.

The high level requirements put on the OSTM/Jason-2 project are expressed in the documents « OSTM/Jason-2 Operations Service Specification » (AD1) , « OSTM/Jason-2 System Requirements » (AD2) and «OSTM/Jason-2 Science and Operational Requirements » (AD10).

These documents provide detailed requirements on mission success, science requirements and goals, mission requirements, orbit, launcher, operations, products definitions and delivery, satellite and instruments requirements, pointing, precise orbit determination, data storage and content, time tagging, ...

Among all these requirements necessary for the conduct of the mission, Level 1 Requirements can be highlighted as the key requirements driving the success of the mission. They are listed below :

1. Provide a minimum of 3 years measurement of ocean surface topography
2. Launch on the same orbit as Jason-1
3. Fly within +/- 1 km of the same 9.9-day repeating ground tracks as Jason-1.
4. Maintain at least the same measurement accuracy than Jason-1 : 3.4 cm (rss; for a typical sea of 2 m significant waveheight and 11 dB sigma0) at 1/sec along-track data rate with a goal of achieving 2.5 cm (RSS) as defined in AD10.
5. Maintain the stability of the global mean sea level measurement with a drift less than 1 mm/year over the life of the mission according to AD10.
6. Maintain the accuracy of significant waveheight to 50 cm or 10% of the value (whichever is greater), sigma0 to 0.7 dB according to AD10.
7. Minimize any relative bias from Jason-1 to less than 5mm.
8. Conduct a verification phase of the mission of at least 10 months to calibrate and validate the mission’s measurement system. During this phase, if Jason-1 is still functioning, orbit phasing of Jason-2 shall

be made to ensure near simultaneous observations with Jason-1 with a time separation less than 10 minutes, with one minute as a goal.

9. Return from the satellite to the ground for processing more than 95% of all theoretically possible data that can be collected in a three-year period

10. Process all recovered over-ocean data obtained during any 12-month period, with no-systematic gaps, into Geophysical Data Records and make data available to the user community.

11. At the completion of the verification phase deliver the Operational Geophysical Data Record (OGDR) , the Interim Geophysical Data Record (IGDR) and the Sensor / Interim Geophysical Data Record (S-IGDR) , and the Geophysical Data Record (GDR) and the Sensor / Geophysical Data Record (S-GDR) according to the data latency given in AD1.

12. Maintain at least the same content, accuracy and timeliness of information in the Near Real Time Products and Offline Products as Jason-1.

The Mission will be judged successful if, at a minimum, the following success criteria are accomplished:

- Achieve a successful launch and the required mission orbit
- Support the long-term ocean surface topography measurements began by TOPEX/Poseidon, with the measurement accuracy of at least 3.4 cm given in AD10, with a mission duration of at least 3 years.
- Capture, process, and deliver the Near Real Time Products for archive and distribution to the user community.
- Capture, process, and deliver calibrated Offline Products for archive and distribution to the user community.

3. MISSION MANAGEMENT

3.1 MISSION OVERALL ORGANISATION

The overall organization of the OSTM Program relies on the following entities and their relationship:

At the level of each participating agencies:

- A **Program Office** is in charge of the programmatic follow up of the program and any matter dealing with international cooperation, coherence with other Earth observation programs, and legal affairs. The Program office shall also be part of all discussions, and decisions on subjects having a major impact on the OSTM program, that is to say potentially bringing the project outside from the defined schedule, budget or performance envelope. The Project Office periodically reports its activities to the Program Office according to internal agencies frequency and rules.
- A **Project Office,** led by a Project Manager, is in charge of all activities regarding development, preparation of operation and mission operation all along the mission lifetime. This Project Office is responsible for the development and operation part of the OSTM system according to the agreed sharing of responsibilities between partners and also according to budget, schedule and performances as defined in the Program Proposal approved by each partner and described in the system documentation. The detailed organisation of this Project Office is under the responsibility of each agency according to its internal management rules. The Project office team shall include or get support on all engineering and management skill deemed necessary in view of the tasks to be accomplished. The project office organization shall clearly identify the people who will be in charge of managing interfaces with partners. The interactions (telecon, meeting etc..) between each project team are described in paragraph 10.3.

The detailed relationship and responsibility sharing between Program and Project Office is very much dependent upon each agency organization and as such can not be given in detail here. This shall be described in each internal Project Management plan.

At the level of the four partners:

- A **Joint Steering Group** (JSG) whose responsibilities and organizational rules are given in paragraph 3.3
- A **Science Team** whose membership and role is given in paragraph 3.4

At bilateral level:

- There will be specific bilateral relationship between the partners, especially when hardware and/or software are exchanged between those. These relationships will be described through dedicated cooperation agreement as it is the case between EUMETSAT and CNES or through any other documentation deemed adequate. These bilateral agreements will be given for information to the other partners. In case of conflict or contradiction between these agreements and the MOU, the MOU shall prevail. The detailed management of deliveries between partners is described in Chapter 11.

3.2 DIVISION OF RESPONSIBILITIES

The division of responsibilities for the OSTM/Jason-2 mission is similar to Jason-1, taking into account the addition of EUMETSAT and NOAA. The main features are given below.

- **NASA responsibilities:**
  - Project Management
  - Launch vehicle
  - Payload
    - Advanced Microwave Radiometer (AMR)
    - GPS Receiver (GPSP)
    - Laser Retroreflector Array (LRA)
  - JPL Payload integration and test
  - Mission Operation support for JPL instruments
- **NOAA responsibilities:**
  - Project Management
  - Ground System & Operations
    - Satellite Operations Control Center (SOCC)
    - CDA Stations (2)
    - NRT product processing
    - All product distribution
    - All archiving
    - Ground network
    - Satellite operations after handover
  - User interface

- **CNES responsibilities:**
  - Project Management
  - Satellite, Proteus bus
  - Payload
    - Nadir Altimeter POS3
    - DORIS tracking receiver package with CARMEN2 - T2L2 - LPT
  - Ground System & Operations
    - Satellite Control Command Center (CCC)
    - OFL product processing and distribution
    - All archiving
    - Ground network
    - Satellite Operations before handover
    - Navigation, Guidance, Expertise for all mission
  - System integration & test
  - Mission Operation support for spacecraft bus and CNES instruments
  - System Coordination for all mission phases
- **EUMETSAT responsibilities:**
  - Project Management
  - Ground System & Operations
    - Earth Terminal (1)
    - NRT product processing, archiving and distribution
    - Ground network
  - User interface

Detailed responsibilities are described for every product/document and for each phase in paragraphs 4 to 11.

3.3 JOINT STEERING GROUP

As required by Article VIII of the MOU "Program and Project management", the partners will establish an OSTM Joint Steering Group (JSG) to provide guidance for the mission. Composition and main duty of the JSG are given in the MOU.

The JSG, which also serves as the steering committee for the level 1 system reviews (as defined in the section 8), will ensure that representatives from all Partners, or each Partner's designees, are invited to serve on the boards of these reviews. The JSG will be co-chaired by NASA and CNES during mission development, until handover of satellite operations, and by NOAA and EUMETSAT following handover of the satellite operations and control functions.

There can be several reasons to convene a JSG meeting.

a) As Steering Committee of a mission/system review as detailed in the Review management section (section 8)

b) As a periodic meeting (once per year) in case there are no mission/system reviews

c) In case of disagreement among the Project and /or Program Managers on a dedicated subject

d) When a decision potentially impacting the mission success criteria or Level 1 requirements and/or adversely affecting the risk ranking as defined through the risk assessment process has to be made timely, outside from a review process.

The JSG meeting can either be a face to face or telecon meeting. In view of anticipated difficulties to find meeting dates affordable by the representatives from the four partners and in order to avoid postponement of urgent decisions, it shall be possible to convene a JSG meeting (face to face or telecon) with the participation of only one representative from each partner.

The attendance of the JSG, in addition to permanent members as listed in the MOU, shall be adapted to the items to be discussed and decisions to be made. Experts on the domain to be considered can be invited to attend a JSG. The list of proposed experts shall be exchanged and approved by the partners. When the JSG meets as Steering Committee for a system review, the review board chairman, assisted by member(s) of the board if necessary is invited to the Steering committee meeting where he will present the review board report.

An agenda of the JSG shall be released by the agency hosting the meeting or convening the telecon sufficiently in advance to be approved by the partners. A summary of actions/decisions taken during the meeting shall also be released by the convening agency and these actions shall be included in the project system action list..

As indicated in the MOU, the JSG decision shall be taken by consensus. If agreement can not be found among the JSG members, Article XXIII "Settlement of Dispute" of the MOU will apply.

The JSG members approve two level 1 documents of the project : These documents are the "Project Plan" and the "Operations Services Specification" (AD1).

3.4 SCIENCE TEAM

The Ocean Surface Topography Science Team (OSTST), co-chaired by the Project Scientists, includes all Principal Investigators (PIs) selected by EUMETSAT, CNES, NASA and NOAA, plus the Project and Program Scientists. The OSTST will advise the Project on aspects of the mission that influence the scientific and operational usefulness of mission data. The interests of the team include: definition of products (near real time, offline and experimental), algorithms for processing the data, plans for verifying and calibrating the data, system design for processing and distributing data, data format, and plans for calculating and verifying a precise ephemeris.

Before launch, the OSTST works with the agencies to assist and guide the Project in the design of the OSTM/Jason-2 Mission and the definition of its output products. After launch, the OSTST has the responsibility for demonstrating the scientific and operational utility of the data to the international research and operational community.

The OSTST will also establish the criteria and guidelines necessary to ensure that the data are used by the PIs in a scientifically useful and effective manner.

The OSTST assists the Project in definition of Project/Science requirements and interfaces. It participates in dedicated "science" reviews to coordinate science requirements, and to advise the Project on mission decisions and the way they affect the science objectives and investigations. The OSTST assists and advises the Project in identifying, planning, coordinating, and conducting data verification activities.

The OSTST jointly discusses and coordinates data analysis techniques and methods, and the publication of the scientific results of investigations relating to the mission. The OSTST communicates and coordinates plans and progress to related international programs.

Because the OSTST is large and meets infrequently (once per year in plenary session), it is better suited to provide general scientific guidance than specific timely advice. To obtain timely answers for day-to-day scientific problems or any critical point whose adequate answer shall be timely given and shall not wait until the next OSTST meeting, the Project will rely on the advice of the Project Scientists. It is up to the Project Scientists, before giving advice to the project, to consult part or all of the members of the OSTST. This consultation will be mainly based on e-mail exchange. This will also be the case in preparation for any decision regarding the OSTST domain of interest that needs to be brought to the attention of the JSG. In such a case, the Project Scientists assisted if deemed necessary by PI's representatives will attend the JSG.

3.5 PROJECT STAFF

3.5.1 CNES PROJECT STAFF

3.5.1.1 PROGRAM MANAGER

The CNES Program Manager, within the Division Observation de la Terre in the Direction des Programmes at CNES, is designated to direct the activities of OSTM/Jason-2 in relation with the CNES Earth Science Program. This Program Manager is responsible to the "Directeur des Programmes" of CNES for assuring that all science goals and requirements established for the Project are met within available resources. The CNES Program Manager is responsible for the overall programmatic contribution of CNES to OSTM/Jason-2.

3.5.1.2 PROJECT MANAGER

The CNES Project Manager is assigned by CNES to provide funding and planning and technical control of the CNES portion of the Project, to report at CNES to the CNES management and to the Direction des Programmes and to coordinate and act with the 4 partner OSTM/Jason-2 Project Managers on all matters which impact overall mission schedule, cost or performance.

The Project Manager is responsible for the French part of the OSTM/Jason-2 activities from definition studies phase till the end of the science verification phase.

3.5.1.3 PROJECT MISSION SCIENTIST

The CNES Project Scientist assists and advises the Project Manager on the scientific mission.

The Project Scientist is responsible for maximizing the scientific return within Project constraints. The Project Scientist co-chairs the Ocean Surface Topography Science Team (OSTST) along with the mission scientists from the other partners and is the primary contact between the PIs and the Project.

The Project Scientist will be responsible for coordinating :

- pre- and post-launch science investigations, assisting planning and conducting of validation activities, and coordinating with the Project for the data production and dissemination activities.

- science requirements, plans, and field experiments with other organizations, whether private, academic, Federal, national, or international.

The Project Scientist will evaluate all scientific requirements and goals, reviewing the Project implementation to ensure that the overall mission approach is consistent with the science objectives.

The Project Scientist conducts, together with NASA, the preparation and release of relevant OSTM/Jason-2 Research Announcements and, in coordination with EUMETSAT, the selection of European Investigators

3.5.1.4 MEASUREMENT SYSTEM ENGINEER

The CNES Measurement System Engineer is in charge of the definition of the data products and of the processing algorithms. For these activities he works in close relationship with the project scientists and the OSTST teams. He leads the data product performance verification activities, and the processing algorithms evolutions definition.

His role is as follows:

- iterate with the Project Scientists to form the product and algorithm review team,

- co-chair the product and algorithm review team with the NASA, NOAA and EUMETSAT MSE , which means prepare and hold review meetings, and be sure that conclusions are transferred to the OSTST in order to define OGDR, IGDR and GDR ,

- understand all core mission sensors onboard Jason-2: serve as liaison to the NASA MSE for understanding POSEIDON-3 and DORIS and interact with him for AMR and GPSP instruments,

- define all altimeter science algorithms, provide input, review and concur to NASA definition of radiometer algorithms,

- perform specifications of all algorithms, ensure that a complete and consistent set of algorithm and instrument constants are made available to the processing system,

- contribute to the OSTM/Jason2 CALVAL working group activities, by contributing to the organisation of the group and soliciting input from OSTST investigators,

- contribute to the establishment of a joint CNES/NASA/NOAA/EUMETSAT CALVAL plan,

- contribute to global product and algorithm verification, ensure that CALVAL results are translated into processing software, and respond to questions from OSTST members on algorithms, data, instruments

3.5.1.5 SYSTEM MANAGER

The CNES System Manager reports directly to the Jason-2 Project Manager.

The System Manager is in charge of all the system definition activities (system definition, operational and scientific products specification, ground system requirements), and of the interfaces coherency between the first level components (in particular the satellite and the ground system). The System Manager is responsible for the mission analysis activities, for the global performance of the system, and is the leader for the system validation activities (technical and operational qualification of the system).

The System Manager is responsible for activities coordination with NASA, EUMETSAT and NOAA at system and ground system level.

The System Manager coordinates the CNES "System and Operations" group. This Group is in charge of the system performance follow on and verification, of the Ground System activities and the Operations preparation.

3.5.1.6 SYSTEM ASSURANCE MANAGER

The CNES System assurance manager is in charge of all the mission assurance activities at system level, including ground system activities. The System assurance manager is in particular responsible for the non conformances control and the risk management activities, and is in charge of the synthesis of the mission assurance activities at project level.

During the system test phase, the System assurance manager is responsible for organizing for each test the Test Readiness Reviews and the Post Test Reviews.

3.5.1.7 PAYLOAD AND LAUNCHER INTERFACE MANAGER

The CNES Payload and Launcher Interface Manager reports directly to the Jason-2 Project Manager.

The Payload and Launcher Interface Manager is responsible for the coordination of the Payload group which is in charge of the Jason-2 instruments development

The Payload and Launcher Interface Manager is in charge of all the Payload level activities (definition, coherency and configuration, budgets, qualification, schedule …) and is responsible for activities coordination with NASA at instrument and satellite level. He is responsible for providing the Satellite Manager with all the necessary information about the payload instruments to perform the development, test and qualification of the satellite.

The Payload and Launcher Interface Manager coordinates launcher activities with NASA including safety aspects and Launch Campaign activities.

3.5.1.8 SATELLITE MANAGER

The CNES Satellite Manager reports directly to the Jason-2 Project Manager.

The Satellite Manager is responsible for the satellite development including the satellite qualification, integration and tests, according to the PROTEUS platform features and taking into account the Jason-2 specificities. He is responsible for the satellite prime contractor contract.

For these activities the Satellite Manager is supported by the CNES experts from the PROTEUS team, by the satellite assurance manager and by the Payload and launcher interface manager.

3.5.1.9 SATELLITE ASSURANCE MANAGER

The CNES Satellite assurance manager is in charge of all the mission assurance activities at satellite and payload level. In fulfillment of this role his responsibilities include reliability, Electronic Parts, Materials, Quality Assurance, System Safety and Qualification programs. In particular he participates to the management of anomalies, waivers and deviations at satellite and payload level, participates to the payload instruments Delivery Review Boards, to the Test Readiness Reviews and Post Test Reviews during the Payload and Satellite AIT.

He is charge of the synthesis of the mission assurance activities at satellite level. He is supported by the Cnes quality experts and by the Systems Safety engineer.

3.5.1.10 PAYLOAD ENGINEER AND I&T MANAGER

The CNES Payload Engineer and I&T Manager is in charge of the technical expertise on all payload interface aspects and in particular to check the compliance of the instruments with the Interface and I&T requirements.

He is responsible for the definition of the Payload I&T Requirements and for coordinating the definition and operation of the payload instrument EGSE during the satellite AIT.

He supervises I&T activities in behalf of CNES project team. He attends tests planning meetings and key-points and is responsible for coordinating any CNES required technical support. He reviews the test requirements ("Demandes d'essais"), test procedures and test reports and is involved in the process of corrective actions decision in case of changes, deviations or any problem encountered during the I&T program.

3.5.1.11 CNES PAYLOAD INSTRUMENTS MANAGERS

Each of the CNES instruments (POSEIDON3, DORIS, T2L2, CARMEN2) , has a lead engineer assigned with the following responsibilities:

- define the instrument functional requirements and design specifications taking into account the satellite interface constraints,

- lead the development, integration, test and calibration of flight hardware, support equipment, and related software,

- prepare the instrument integration activities on the spacecraft.

- is responsible for the instrument schedule and for the instrument scientific performances.

3.5.1.12 GROUND SYSTEM MANAGER

The CNES Ground System Manager is responsible for establishing the OSTM/Jason2 Ground System Architecture and Operation Requirements, as well as the interfaces between all the ground system elements.

He is responsible for coordinating the team in charge of the definition, implementation and validation of the CNES elements of the OSTM/Jason2 ground system. He shall ensure the maximum reuse of the existing Jason-1 ground system.

He participates in the ground system validation activities and in the preparation of the operations.

3.5.1.13 SYSTEM TESTS MANAGER

The CNES System Tests Manager is responsible for the definition and the implementation of the system tests plans (compatibility tests between the different system elements, satellite/ground tests, routine operation tests, general rehearsals). He will ensure that the means and tools necessary for these tests are available.

He is responsible for coordinating the different teams involved in the system tests (CNES internal teams and teams from EUMETSAT, NASA and NOAA).

3.5.1.14 MISSION OPERATION MANAGER

The CNES Mission Operation Manager is responsible for preparing the OSTM/Jason2 mission operations . For that, he prepares the operations documentation, ensures that all the necessary means are available, and coordinates the operations teams for preparing and running the operational qualification tests and the in-flight assessment tests.

3.5.2 EUMETSAT PROJECT STAFF

3.5.2.1 PROGRAM MANAGER

The EUMETSAT Program manager is responsible of the overall programmatic contribution of EUMETSAT to OSTM/Jason-2. The Program manager is one of the two EUMETSAT representatives to the JSG and to the J2-JSG and is interfacing between the project and the EUMETSAT delegate bodies.

3.5.2.2 PROJECT AND SERVICE MANAGER

The EUMETSAT Project and Service Manager is responsible for managing the contribution of EUMETSAT to the deployment, verification and operations of the OSTM/Jason-2 system, and the related interactions with the OSTM programme partners. The Project and Service Manager reports to the Director of the Operation Department and will be an integrated member of the EUMETSAT operations management team.

3.5.2.3 PROJECT MISSION SCIENTIST

The EUMETSAT Mission Scientist will serve as Jason-2 Mission Scientist as part of his global responsibility of EUMETSAT Ocean Mission Scientist providing scientific expertise in the field of oceanography and remote sensing of the ocean with focus on altimetry and scatterometry. The Mission Scientist will co-chair the OSTST along with the mission scientists from the other partners. The Mission Scientist will support the OSTM/Jason-2 Research Announcement, in cooperation with the other partners, assess the relevance of research to the development of operational applications, and organize the dialogue between the research and operational user communities, with a view to stimulating the transfer of research results to operations. The Mission Scientist will represent EUMETSAT in international for addressing the use of meteorological satellites in oceanography. He will also act as the EUMETSAT Measurement System Engineer.

3.5.2.4 ENGINEERING TEAM LEADER

The EUMETSAT Engineering Team Leader will be coordinating the team in charge of the definition, implementation and validation of the EUMETSAT Jason-2 ground system, which will host the CNES provided elements and interface and communicate with the other ground system elements through the network. The Engineering Team Leader shall ensure a maximum re-use of existing EUMETSAT infrastructure and that the Jason-2 ground system operations are adequately integrated in the overall EUMETSAT structure.

3.5.2.5 OPERATION/PRODUCT ENGINEER

The EUMETSAT Operation/Product Engineer will be responsible for the operational qualification and testing of the EUMETSAT Jason-2 ground segment and its interfaces within the overall OSTM/Jason-2 ground system. The Operation/Product Engineer will then be in charge of the coordination of OSTM/Jason-2 operation and product validation and production at EUMETSAT.

3.5.3 NASA/JPL PROJECT STAFF

The NASA Program Manager or Program Executive (PE) within the Earth-Sun System Division at NASA-HQ is designated to direct the activities of OSTM within NASA. The PE is responsible to the director of the Earth-Sun System Division within the NASA Science Mission Directorate for assuring that all science goals and requirements established for the Project are met within available resources. The PE is responsible for the overall programmatic contribution of NASA to OSTM.

The Project Manager (PM) is responsible for the overall success of the NASA contributed project elements. The PM is responsible for design, development, test, mission operations of all NASA elements, and for coordination of the work of the contractors. The PM programmatically reports to the NASA-JPL Director for Earth Science and Technology Directorate. The PM informs JPL, NASA, and 4 partner management on the status and progress of the project, and coordinates with other organizations involved in or supporting project activities. The PM works with the partner project managers on all matters which impact overall mission schedules, cost or performance.

The project scientist is responsible for the scientific integrity and overall scientific success of the project. scientific integrity and overall scientific success of the project. The OSTST will be co-chaired by the Project Scientist along with the mission scientists from the other partners. It includes representatives from NOAA and EUMETSAT, and the investigation scientists.

The NASA Headquarters Program Scientist for OSTM will provide for the solicitation, selection and balance of the Ocean Surface Topography Science Team. The Program Scientist assures that the mission science is effectively integrated with that of related research and missions, and that key areas of calibration/validation and data management are reflected in project plans. The Program Scientist will participate in and, where appropriate, provide scientific leadership to the international science/mission activities involving interaction of NASA with its interagency and international partners.

The Project Scientist will:

- Ensure that the Level 1 science requirements are met. Lead the development of Project-level science requirements. In all phases of the project (formulation, implementation, and operations), provide expert interpretation of the science requirements for the project.
- Collaborate with the Project Manager on all issues affecting the scientific success of the project, and respond in a timely manner to requests from the Project Manager for advice or assessment of science-related issues.
- Maintains oversight of the scientific aspects of all phases of the project.
- Ensure that the scientific return of the project is maximized within the project constraints.
- Represent the Scientific Investigators of the mission to the Project and to NASA.

The System Engineering Manager (SEM) is responsible for overseeing and advising the Project Manager on matters related to project-wide systems engineering, requirements allocation and flow-down, Project Plan development, mission design and navigation, launch vehicle integration and launch services, range safety, and other such systems level tasks. The System Engineering Manager provides technical support to the Project Manager and is accountable to him for assessing the system compliance with requirements, at large, and the ability of the OSTM system to achieve mission success and meet the science objectives. He also supports all 4 partners in identifying and solving system level trades, issues or problems.

The SEM leads the Project-level systems engineering team supported by the Launch Vehicle Integration Engineer, Payload Systems Engineer, Configuration Management Engineer, Instrument Engineers, and Integration and Test Manager) and any other project support elements including system contractors. The SEM also implements the project risk management process and works with the project manager to track and manage risks at the project level.

The Payload System Engineer (PSE) will manage the OSTM Payload level requirements and interfaces, provide technical leadership for interface definition, and manage the trade studies for risk mitigation. For OSTM the Payload refers to the three NASA instrument (AMR, GPSP, LRA). The PSE is responsible for instrument level design, requirements development and flowdown, trade studies and baseline definition, partitioning the payload to Instruments, subsystems and elements, development and maintenance of the margins and allocation process, and technical coordination. The PSE is the primary technical interface with regards to Instrument development, integration, interfaces and operation. The PSE works with the instrument engineers and I&T manager to coordinate; Payload Requirements, Validation, and Verification, Payload Design and Compatibility, Payload Performance and Analysis, Payload Accommodation.

The Business Manager will oversee performance management, contract management, resource management and all other activities related to the business aspects of the Project.

The Mission Assurance Manager is responsible for assuring mission success for all aspects of the project, and will coordinate with the partners' product assurance office. The Mission Assurance Manager (MAM) reports to the Project Manager. Responsibilities of the MAM include : designing the Reliability, Electronic Parts, Materials, Quality Assurance, System Safety and Environmental Qualification Programs. During the implementation phase of instrument development, the MAM is responsible for the management of the aforementioned activities

The System Safety Engineer (SSE) provides Flight Project technical safety by identifying, assessing, and mitigating risk to personnel or critical hardware. The SSE supervises and maintains the technical aspects of the OSTM Systems Safety Program. The SSE co-chairs, together with Project Manager, Safety Steering Committee Meetings to resolve safety concerns, review safety documentation and guide the Program in its' safety endeavors. The SSE also supports JPL, Contractor and (as applicable) partner design/ test/ operations, evaluates contractual safety documents, reviews and approves hazardous operations procedures. The SSE also consults with NASA Headquarters and other NASA Centers in the development and review of safety related requirements and documents.

The Launch Vehicle Integration Engineer (LVIE) is delegated by the JPL Project Manager as responsible for the Management of the launcher and launch support contract. He is the contact point between NASA-KSC/Boeing and the Project during the Project development and launch campaign. He is responsible for the preparation of the documentation associated with the Delta II launch. He will review/approve technical documents passing between the Project and Boeing. Examples are Mission specification, Interface Control Document, safety submissions, mission analysis input files, test plan, launch campaign documents, and post-launch documentation. The LVIE is in charge of assessing the compatibility between the satellite and Delta II. He is responsible for launch integration meeting organization, and he works with the CNES Launcher/Satellite interface engineer and with the Satellite I&T manager on LV - Satellite integration.

Each of the NASA instruments (AMR, GPSP, LRA) has a lead engineer assigned with the following responsibilities:

- Prepare the instrument functional requirements and design specifications.

- Establish interface agreements regarding the instrument and other applicable hardware on the host spacecraft.

- Lead the development, integration, test and calibration of flight hardware, support equipment, and related software.

- Keep the Project Manager and line managers informed concerning status and progress, and solicit assistance in solving problems. When the instrument development requires a significant contracted effort, the Instrument engineer may also function as a Contract Technical Manager (CTM). If the size of the subcontract requires a dedicated CTM, the Instrument Engineer will partner with the CTM to ensure that there is beneficial impact from the contractor's performance.

3.5.4 NOAA PROJECT STAFF

3.5.4.1 NOAA POLAR PROGRAM MANAGER

The NOAA Polar Program Manager will coordinate the NOAA OSTM/Jason-2 Project within the overall Polar Program within the Office of Satellite Development (OSD). This involves determining the budget, allocating resources, and advising the Jason-2 project working group of cross-project schedule and resource dependencies. The NOAA Polar Program Manager serves as the NOAA point of contact with the other Parties regarding NOAA's role in achieving mission milestones. In fulfilment of this role, the Program Managers responsibilities include:

- Defining the nature of NOAA's participation in the achievement of the Milestones,
- Communicating the nature of that participation to the co-leads, OSD management, and the managers of NOAA departments contributing resources to the working group,
- Acquisition of (NOAA) internal and (contractor) external resources
- Resolving cross-NOAA issues that might delay the achievement of a milestone,
- Representing NOAA's position to the other MOU Parties on issues relating to NOAA's role in the achievement of these milestones

3.5.4.2 PROJECT MANAGER

The NOAA OSTM Project Manager ensures the fulfilment of NOAA's responsibilities according to the terms of the OSTM Four Party Memorandum of Understanding (MOU) (RD1). These include system engineering, definition of program requirements, operations and operational support (including facilities), and delivery of user products. The Project Manager defines the means of implementing program requirements, establishes milestones and schedules, and assembles, justifies, and presents program and budget information for implementing approved polar programs.

- The OSTM Project Manager's responsibilities include:
- Preparation and implementation of the NOAA OSTM/Jason-2 System Project Plan
- Managing activities of the OSTM Ground Systems Working Group
- Coordination of NOAA's contributions to 4-party documents
- Coordination of NOAA's participation in 4-party design reviews
- Coordination of development and maintenance of operations concept
- Coordination of NOAA-only document development
- Coordination of NOAA-only design reviews
- Preparation of NOAA's budget input for upgrading the Polar Ground Segment
- Coordination of configuration changes between NOAA and the other 3 parties (NASA/JPL, EUMETSAT, and CNES)

3.5.4.3 GROUND SYSTEM IMPLEMENTATION MANAGER

The Ground System Acquisition and Implementation Manager 's responsibilities include:

- Co-leadership and management of the OSTM Ground Systems Working Group
- Coordination of satellite-to-ground Interface Requirements Documents (IRDs), including development of interfaces from NOAA to external Earth Terminals (ET)
- Implementation activities of ground segment upgrades
- Integration and Test activities of NOAA Polar Ground System to support OSTM/Jason-2
- Definition and implementation of Ground System operating procedures in support of the Jason-2 satellite and the OSTM
- Requirements monitoring, tracking, and change control

- Obtaining any ground personnel operational training and documentation requirements

3.5.4.4 PROJECT MISSION SCIENTIST

A representative from the Office of Research and Applications (ORA) is assigned as the OSTM/Jason-2 Mission Scientist. The Mission Scientist:

Prior to operational handover:

- Provides input to CNES and JPL on the development of algorithms to be incorporated with the product processing systems
- During the assessment phase, provides assistance with instrument calibration/validation and satellite navigation and orbit determination for Jason-2 satellite orbital data streams

After operational handover

- Support CNES validation activities for the products generated by the product generation software
- Assist Office Satellite Data Processing and Distribution (OSDPD) / Environmental Satellite data Processing Center (ESPC) with implementation and operations of NRT products' quality assessment software.

He will also act as the NOAA Measurement System Engineer.

3.5.4.5 OPERATIONS ENGINEER

A representative from the Office of Satellite Operations (OSO) is assigned as the OSTM/Jason-2 Operations Engineer. The operations Engineer:

- Oversees the operation of Jason-2 satellite on a 24 hour per day, seven days per week basis
- Leads activities for preparation of Operational Requirements
- Monitors acquisition projects for integration into ground segment elements operated by Office of Satellite Operations (OSO)
- Is responsible for interfacing with both the Scheduling and Operations personnel within OSO.
- Is responsible for addressing daily ground system issues and testing that are needed.
- Supports and participates in verification and validation activities.
- Is responsible for the operational qualification and testing of the NOAA Jason-2 ground segment and its interfaces within the overall OSTM/Jason-2 ground system.

3.5.4.6 NRT PRODUCT ENGINEER

A representative from the OSDPD will serve as OSTM Near Real Time Processing Engineer. This Near Real Time Processing Engineer is :

- In charge of the integration of Near Real Time data processing system within the NOAA operational environment.
- Responsible for technical and operational qualification and testing of these elements.
- In charge of interface between ESPC system and the rest of the NOAA OSTM ground segment.
- Serves as the primary interface with the user community for Near Real time data and products.

3.5.4.7 ARCHIVE AND ACCESS ENGINEER

A representative from OSD will serve as the OSTM/Jason-2 Archive and Access Engineer. The Archive and Access Engineer will be responsible for:

- Development of an agreement on the interface between the Comprehensive Large Array-data Stewardship System (CLASS) and the ESPC for ingest of the OSTM/Jason-2 data products
- Identification of the changes to be made to the CLASS for archival of the OSTM/Jason-2 data products and for distribution of such archived products to the designated user community

Development and integration and test (I&T) of the identified changes into the CLASS to ensure that CLASS is capable of supporting the OSTM/Jason-2 operationally

4. MISSION ASSURANCE

4.1 MISSION ASSURANCE MANAGEMENT

4.1.1 SPECIFICATIONS

The top level Mission Assurance requirements applicable to the OSTM/Jason-2 mission shall be described in a dedicated document : “OSTM/JASON-2 4 PARTNER MISSION ASSURANCE POLICY” (AD14)

All participating agencies within OSTM are committed to fulfill these management rules and apply rules and standard enabling to achieve this commitment.

It is the responsibility of each of the OSTM implementing agency to ensure that the development, testing or operation of any element of the OSTM system under its responsibility is done according to its own Mission Assurance practices and that these practices are compliant with the OSTM Mission Assurance policy.

This applies either to the elements directly developed by the agency or sub-contracted by the agency.

These mission assurance rules shall be described in a Mission Assurance Plan developed by each agency. This plan can be a set of standard requirements or procedures applicable within the Agency or tailored to a specific activity or contract in the frame of OSTM/Jason-2.

The mission assurance plan developed by each implementing agency shall be made available to the other partners for verification of consistency and coherency between the different plans.

In case of a major discrepancy, major being understood as having a potential impact on the compliance with the Mission Assurance Policy, this discrepancy shall be discussed at project manager level with the support of their Mission Assurance team in order to suppress it or at least to make it acceptable with respect to the Mission Assurance specification and the result of this shall be traced in the Mission Assurance Plan.

Any remaining discrepancy, which can not be solved at Project manager level, shall be brought up to the JSG for final decision.

4.1.2 ANOMALY MANAGEMENT

The anomaly management process between the 4 partners shall be described in the “OSTM/JASON-2 4 PARTNER MISSION ASSURANCE POLICY” document (AD14).

Here again, each agency shall apply its own anomaly management process and tools.

Nevertheless, exchange of anomaly list and description file shall be possible across the various partners.

Each partner shall make available to the others its anomaly list in order for the upper level (system) to check that anomaly having potential impact at system level are well identified and addressed at that level.

4.2 SAFETY

In addition to the above-described Mission Assurance process including Reliability, Availability, Maintainability, Security (RAMS) activities, a dedicated activity dealing with Safety is needed, which general process is described hereafter. The two main activity periods where safety requirements apply are the satellite Assembly, Integration and Test (AIT) sequence, and the Launch Campaign.

During satellite AIT sequence, the requirements will be those in place at the satellite contractor premises. These requirements shall be provided in due time to instruments and Electrical/Mechanical Ground Support Equipment (EGSE/MGSE) contractors in order for them to include these requirements in their design process. These requirements are included in each “Instrument Interface Specification” (IIS) document.

For the Launch campaign, the NASA safety requirements shall be made available to all partners.

A tailoring process of these requirements shall then take place taking into account the precise characteristics of the Jason-2 satellite such as type and amount of propellant, pyro classification…..This tailoring process shall take place early enough in order to avoid late modification that would have dramatic impact on the overall cost and schedule. Moreover, any applicable heritage from prior PROTEUS missions (Jason-1, CALIPSO) which went through the same process shall be taken into account. The modification with respect to the applicable PROTEUS requirements shall be minimized and clearly identified.

These tailored requirements (AD11) will be applicable for the satellite including the instruments and associated MGSE/EGSE and shall cover the entire launch campaign sequence.

As for Jason-1, and answering to these requirements, a safety analysis (AD22) shall be prepared by CNES with the support of industry and with provided information by the other partners on the elements under their responsibility.

A first release of this safety analysis shall be made available to the safety authorities by the beginning of satellite Phase C with a clear indication of potential non-compliance with respect to tailored requirements.

As soon as a major non conformance is detected, the point shall be addressed at project level and with the safety authorities in order to solve it and the proposed solution brought up to the JSG.

In addition to this safety analysis, a safety plan describing the safety organization and role and obligation of each partner during the various phases of the Launch Campaign shall be issued.

NASA/JPL is the implementing agency for safety **for the NASA instrument**, Launch Vehicle and Launch site processing services.

4.3 RISK ASSESSMENT

Risk management is the process that identifies project elements/events, both technical and programmatic that could cause the mission to fail and not meet its objectives, should they occur. The process involves the analysis of these elements/events as to their likelihood, their impact, and their relative priority, and then develops and implements control plans for mitigation, containment, acceptance, or other action. Risk management assures that risks are tracked and that information about elements/events with high risk is communicated across all levels of the Project.

Detailed policy about risk management is described in OSTM/JASON-2 4 PARTNER MISSION ASSURANCE POLICY (AD14)

4.3.1 RISK MANAGEMENT POLICY

All major Project elements/events having both high probability of occurrence and high impact/severity (see AD14) to the success of the mission shall be identified, analyzed and documented.

The following shall be included in the documentation for each credible risk element/event regardless of probability :

- Description of the element/event and the assessed Level of risk of occurrence
- Description of the consequences
- Mitigation plans, if any
- Characterization of the risk as "acceptable" or "unacceptable"

4.3.2 RISK MANAGEMENT PROCESS

The Project shall develop and maintain a risk register which lists elements/ events with the greatest potential of impacting the mission in an adverse way should they occur. For those elements/events which are both credible and likely to occur and based on the recommendation of Project Systems Engineering, the Project management team will assess and determine what proactive actions should be implemented. Risk management is a process that continues iteratively throughout the project life cycle. Risk management status shall be reported at major project reviews as appropriate but also at any time during the project if circumstances dictate to do so. In this case, the JSG is the appropriate reporting assembly and will in this case be assisted by expert of the domain in question.

Any decision regarding the acceptability of a risk (in terms of impact gravity and/or probability of occurrence) shall not be the unique decision of the project engineering team and the project manager(s) but shall also be endorsed at JSG level following recommendation by review steering committee or dedicated panel of experts.

4.3.3 RISK MANAGEMENT IMPLEMENTATION

The techniques which can be utilized by the OSTM/Jason-2 Project to identify risks and to track the status of on-going risks are described in AD14. These techniques apply across the Project and at all Project levels and serve to ferret out the risks that need to be analyzed and evaluated in detail to a final disposition by the risk management process previously described.

5. SYSTEM AND OPERATIONS

5.1 SATELLITE AND PAYLOAD INSTRUMENTS

The satellite includes the satellite bus and the instruments constituting the payload.

The satellite bus itself is made up of a platform based on the PROTEUS definition, a payload instrument module and a launcher adapter.

The PROTEUS platform includes the support functions for on-orbit operations, including provision of electrical power, command and data handling, science data storage, attitude control, orbit station keeping, thermal control, and S-band up-link and downlink telemetry and telecommand. Additionally, the Platform provides the Payload with discrete and analog channels, which can be monitored on-orbit by the Platform or on the ground, as well as the following data to the Payload via the Mil-Std-1553B bus: Time and Satellite attitude data.

The payload instrument module supports the Jason-2 payload and provides the required functions (mechanical, thermal...) and interfaces (harness, data bus...).

The platform and the payload module are developed under CNES contracts with Alcatel. The platform will be a protoflight, the qualification of the generic PROTEUS platform being acquired through the PROTEUS program, including the Jason-1 and Calipso satellite development.

The integration and test of the payload instruments on the payload module is performed by Alcatel under CNES contract.

5.1.1 PAYLOAD CONFIGURATION

The core Jason-2 payload consists of the suite of the following science instruments:

- a two frequency altimeter named POSEIDON 3 and its associated antenna, provided by CNES and developed by Alcatel under CNES contract
- a three frequency radiometer and its antenna named Advanced Microwave Radiometer (AMR) provided by NASA
- a Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) receiver package with a DORIS receiver and its associated antenna, provided by CNES and developed by THALES under CNES contract
- a laser retroreflector array (LRA) provided by NASA
- a high precision GPS space receiver (GPSP) and its antennas, provided by NASA.

DORIS package will also include optional added passenger instruments :

- two detectors of particles and radiations named CARMEN2 (Environment Characterization and Modelisation) and LPT (Light Particle Telescope) provided by CNES
- a Laser Link Time Transfer system(T2L2) provided by CNES

In addition to their own scientific objectives these optional instruments are expected to allow the improvement of the DORIS oscillator performance. Addition of the optional instruments will be decided according to their readiness without any impact on the OSTM mission.

For the passenger instruments the accommodation constraints are :

- No impact on Core mission accommodation (spacecraft architecture, command control, power)

- No risk on Satellite
- No operational constraints
- Experiments can be switched off at any time.
- Instruments shall not impact the development schedule

CNES will develop an implementation plan for the optional instruments which describes the conditions under which the experiments would be replaced by mock-ups to ensure a consistent and timely decision process to manage unexpected changes in the optional instrument development plans or any unforeseen risk/impacts to the core mission.

5.2 LAUNCHER

For Jason-2 the Launcher will be based on a Boeing Delta II rocket compatible with the Jason-2 satellite and OSTM mission requirements according to RD1.

The Payload Interface will be : 3715C PAF (same as Jason-1) to maintain 37" diameter clampband interface

The Launch site will be Vandenberg Air Force Base (VAFB) in California - USA.

The Launch Vehicle (LV) Authority to Proceed (ATP) is expected after the NASA Mission Confirmation Review (conducted 6 – 8 weeks after the Mission/System PDR). The exact LV configuration taking into account all technical constraints and variances will be baselined by the time of the ATP.

The LV implementation will follow the NASA standard development process and will be coordinated via telecon and meetings between JPL, Kennedy Space Center (KSC) and CNES. This process will be formalized with in a LV implementation plan.

5.3 GROUND SYSTEM ARCHITECTURE AND OPERATION CONCEPT

The four OSTM Partners will jointly establish and operate an OSTM ground segment including all elements and all facilities required to operate the Jason-2 satellite, acquire its telemetry, process, distribute, and archive data and Data Products, deliver near real time and off line services to operational and research users.

The ground system architecture with the description of all the main constituting elements, their functions, and interfaces as well as the way this system will be operated during the various phases of the mission are described in the document "OSTM/JASON-2 GROUND SYSTEM REQUIREMENTS, ARCHITECTURE AND OPERATIONS CONCEPTS" (AD4)

The description of the tasks to be implemented at Jason-2 Ground System level, mainly Technical Integration (IT), Ground Technical Qualification (GQT), Technical Qualification (QT) and Operational Qualification (QO) tasks is given in this document and in the document "OSTM/JASON-2 SYSTEM TESTS REQUIREMENTS" (AD7) which details the sequencing of the Ground tests in these phases.

The ground system consists of a control ground system and a mission ground system:

5.3.1 CONTROL GROUND SYSTEM

It includes :

a Satellite Control Center (J2CCC) located in Toulouse (France) provided by CNES

This center monitors the satellite during the complete mission life time. Satellite control and operations are executed from this center until the Handover Review in the operational phase. Following this milestone, operations plan preparation, navigation functions, platform configuration changes as well as performance and trends analysis are still this center's responsibility while flight operations including satellite activities scheduling, command plan preparation, command transmission and telemetry acquisition and routing are transferred to the NOAA Satellite Operations Control Center (SOCC).

a Satellite Operations Control Center (SOCC) located in Suitland near Washington D.C (USA) provided by NOAA

This center will be used from the launch till the Handover Review to manage the NOAA stations for routine telemetry dumps (TM and TC) and as a support for contingency operations including commanding if needed. From the Handover Review satellite control and flight operations are executed from this center for the remainder of the mission.

an Earth Terminal/Stations Network

The CNES control center and the NOAA operation control center rely (for command transmission and data acquisition) upon a ground terminal network of earth terminal/stations suitably located to allow the required orbit coverage compliant with the data latency requirement.

This Earth Terminal/Stations Network is composed of :

the NOAA Fairbanks Command and Data Acquisition (FCDA) Station located in Alaska (USA)

the NOAA Wallops Command and Data Acquisition (WCDA) Station located in Virginia (USA)

the EUMETSAT Usingen Earth Terminal (USG) located in Germany.

The Earth Terminal/Stations Network performs satellite telemetry capture, its recording and distribution to the control centers and to the mission centers. The Earth Terminal/Stations also perform the uplink commanding to the satellite.

5.3.2 MISSION GROUND SYSTEM

It includes :

a CNES mission system, with a mission center SSALTO multi-missions ground system (Segment Sol Multimission Altimétrie et Orbitographie) for CNES instrument programming and monitoring (POS3 altimeter and DORIS), for Precise Orbit Determination (POD) , for products generation and for data and products archiving and distribution for the mission, a Near Real Time (NRT) facility management (operations support and maintenance), a Doris system beacons network and associated maintenance service and Service Altimetrie et Localisation Precise (SALP) experts, for a long-term quality check

a EUMETSAT mission center with a near real time processing center, and a data and products archiving and distribution infrastructure for the mission.

a NOAA mission center with a near real time processing center and a data and products archiving and distribution infrastructure for the mission.

a NASA/JPL mission center for JPL instrument programming and monitoring and for command requests generation (AMR, GPSP).

Passengers mission centers for Passengers instruments programming and monitoring and for command requests generation (T2L2, LPT, CARMEN2).

5.3.3 OPERATIONS CONCEPT

The OSTM/Jason-2 operation concept is to be as close as possible to Jason-1 operations. The Jason-1 operational documentation will be used as a reference to build the Jason-2 operational documentation.

The new partners (EUMETSAT, NOAA) operations specificities will be taken into account as far as possible to build the different frames (LEOP, Nominal operations, …) of the OSTM/Jason-2 Operations.

After launch the 4 partner operation coordination will be made through weekly teleconferences named Operational Coordination Group (OCG). OCG will at least involve :

- CNES satellite operational mission manager, who chairs the meetings,
- CNES Responsible for Operations (ROPS), secretary of the OCGs
- NOAA Operations engineer
- NOAA Jason-2 project representative
- CNES operational teams on duty,
- CNES SALP mission manager
- CNES Jason-2 project representative
- EUMETSAT Jason-2 Operation/Product engineer
- EUMETSAT Jason-2 project representative
- JPL Instrument manager
- JPL Jason-2 project representative

The OCG will analyze the satellite and ground status and will prepare all the satellite and ground operations to be conducted in the weeks following the OCG.

5.4 DATA PRODUCTS

“Data Products” are those resulting from processing the Payload Instrument Data and any necessary supporting Housekeeping Data and/or ancillary data. These fall into two general categories:

a. Near Real Time (NRT) Products, available within a few hours of acquisition by the satellite; and

b. Offline (OFL) Products, available with a delay of several days or weeks after additional processing.

Data Products will be, at a minimum, consistent with TOPEX/Poseidon and Jason-1 data products.

5.4.1 OSS DATA PRODUCTS

The products which will be provided by the partners with an associated operational service to the users will be defined in the “Operations Services Specification (OSS)” - AD1.

Five different data products shall be produced and distributed to the users :

1. Operational Geophysical Data Record (OGDR)
2. Interim Geophysical Data Record (IGDR)
3. Sensor - Interim Geophysical Data Record (S-IGDR)
4. Geophysical Data Record (GDR)
5. Sensor - Geophysical Data Record (S-GDR)

The first one is a NRT product. The other four are OFL products.

The description is given in AD1.

5.4.2 NON-OSS DATA PRODUCTS

The Non-OSS products and associated services will be defined during the OSTM/Jason-2 project development. They will be described in a dedicated partner documentation.

These products could be :

- SSALTO/DUACS products
- possible coastal zone products
- possible in land water products
- etc…

5.5 DATA PROCESSING , ARCHIVING AND DISTRIBUTION

5.5.1 DATA EXCHANGE

During all OSTM Phases, EUMETSAT is responsible for making available all Telemetry acquired at the European Earth terminal to the other Partners (see AD4).

During all OSTM Phases, NOAA is responsible for making available all Telemetry acquired from the NOAA CDA Stations to the other Partners (see AD4)

5.5.2 OSS DATA PRODUCTS PROCESSING AND DISTRIBUTION

The processing and distribution requirements for OSS products are given in AD1.

According to the division of responsibility, near real time product generation and distribution is a EUMETSAT and NOAA responsibility while production of the offline product is performed only by CNES. Off line products distribution is a CNES and NOAA responsibility.

CNES and NOAA will permanently archive and provide access to all OSTM/Jason-2 telemetry, products and ancillary data (e.g. commands). This is true whether the information originates at NOAA, EUMETSAT or CNES.

NOAA will generate the NRT products from Payload Telemetry (PLTM) originating at NOAA ground sites. The NRT products will be validated, and accountability and quality reports will be generated. NRT products will be available to users via two methods: retrieval by the customer or automatic delivery to a customer site. Higher-level products will not be available for automatic delivery but will have to be requested by the user for either electronic retrieval or dissemination by other media such as DVD.

EUMETSAT will generate the NRT products from PLTM originating at EUMETSAT ground sites. The NRT products will be validated, and accountability and quality reports will be generated. EUMETSAT will permanently archive and provide access to all NRT products (OGDR). NRT products will be available to users via EUMETSAT dedicated broadcast system

CNES will generate the OFL products from all received PLTM. The OFL products will be validated, and accountability and quality reports will be generated according to AD1.

CNES and NOAA will make OFL products available to users via their own distribution system through one of the two methods: retrieval by the customer or automatic delivery to a customer site.

CNES is responsible for definition, specifications, software development and validation for POSEIDON-3 altimeter algorithms.

NASA is responsible for the definition of AMR algorithms.

CNES is responsible for specifications, software development and validation for radiometer algorithms.

CNES is responsible for the development of the OGDR production software.

EUMETSAT is responsible for the delivery of the software (and its specification) translating native format OGDR into Binary Universal Form for the Representation (BUFR) format OGDR

CNES is responsible for the specifications and development of the offline (IGDR, S-IGDR, GDR, S-GDR) production software.

CNES is responsible for the definition, specification, software development and validation for Precise Orbit Determination except GPS pre-processing algorithms definition.

NASA is responsible for the definition of GPS pre-processing algorithms.

It should be noticed that all algorithm definition documents will be available to 4 partner Science Team and to the Principal Investigators (PI) in the frame of OSTST meetings or dedicated algorithms review meetings.

5.5.3 NON-OSS DATA PRODUCTS PROCESSING AND DISTRIBUTION

Non-OSS Data Products will be processed according to each partner product definition.

The partner which generates the Non-OSS data products is responsible for the products archiving and distribution.

Non-OSS Data Products contents could be presented to the OSTST.

5.5.4 USER SERVICES AND OUTREACH ACTIVITIES

Each Party being in contact with users shall ensure the proper implementation of a user service ensuring proper recording and follow up and closure of user request or inquiries. A Procedure for exchanging information between User services will be implemented to ensure:

a) Questions related to, or, of the responsibility of, another User Service / Partner will be quickly forwarded to the relevant User Service (example: all questions related to EUMETCast will be sent to EUM)

b) User logging will enable identification of users. CNES/NOAA /EUM will exchange their users list.

c) Messages sent to "all users" will be coordinated between user services to avoid risk of contradiction.

d) Distribution of documentation to users will be coordinated between the 4-party

Each Party will also develop outreach activities ensuring release of public information regarding their activities and promotion of mission results and achievement. Outreach activities addressing system activities will need to be coordinated among the partners before release to the public. This refers to outreach tasks performed at the occasion of important programme milestones (Agreement signature, preparation of launch...) where all partners are involved or when addressing global mission results.

Points of contact shall be identified by each Partners in these two areas

5.6 INTEGRATION AND TESTING

5.6.1 SATELLITE

ALCATEL is responsible with the support of CNES and NASA for the definition and execution of all satellite Assembly, Integration and Test (AIT) activities to be performed. Instruments suppliers (CNES and JPL) will provide the required instruments AIT requirements in a document called “Jason-2 payload integration and test requirements" and under CNES responsibility. The input given in this document will be used by the satellite contractor to build the Satellite AIT Plan and associated detailed procedures.

The instrument suppliers will operate the instruments GSE for instruments test sequence preparation, execution and validation of the test sequence.

Detailed organization and responsibilities during the Payload module and Satellite Assembly, Integration and Test phases are described in the « Jason-2 Integration and Test Organization (AD8) document »

5.6.2 GROUND SYSTEM

Each partner will generate an Integration and Test Plan. This plan will address how the components they are responsible for will be integrated. Once the Integration and Test activity begins, each partner will disseminate the status of their integration and test to the other partners. This will help all partners in planning for the 2 by 2 integration of the J2GS elements. These activities are made in the IT phase.

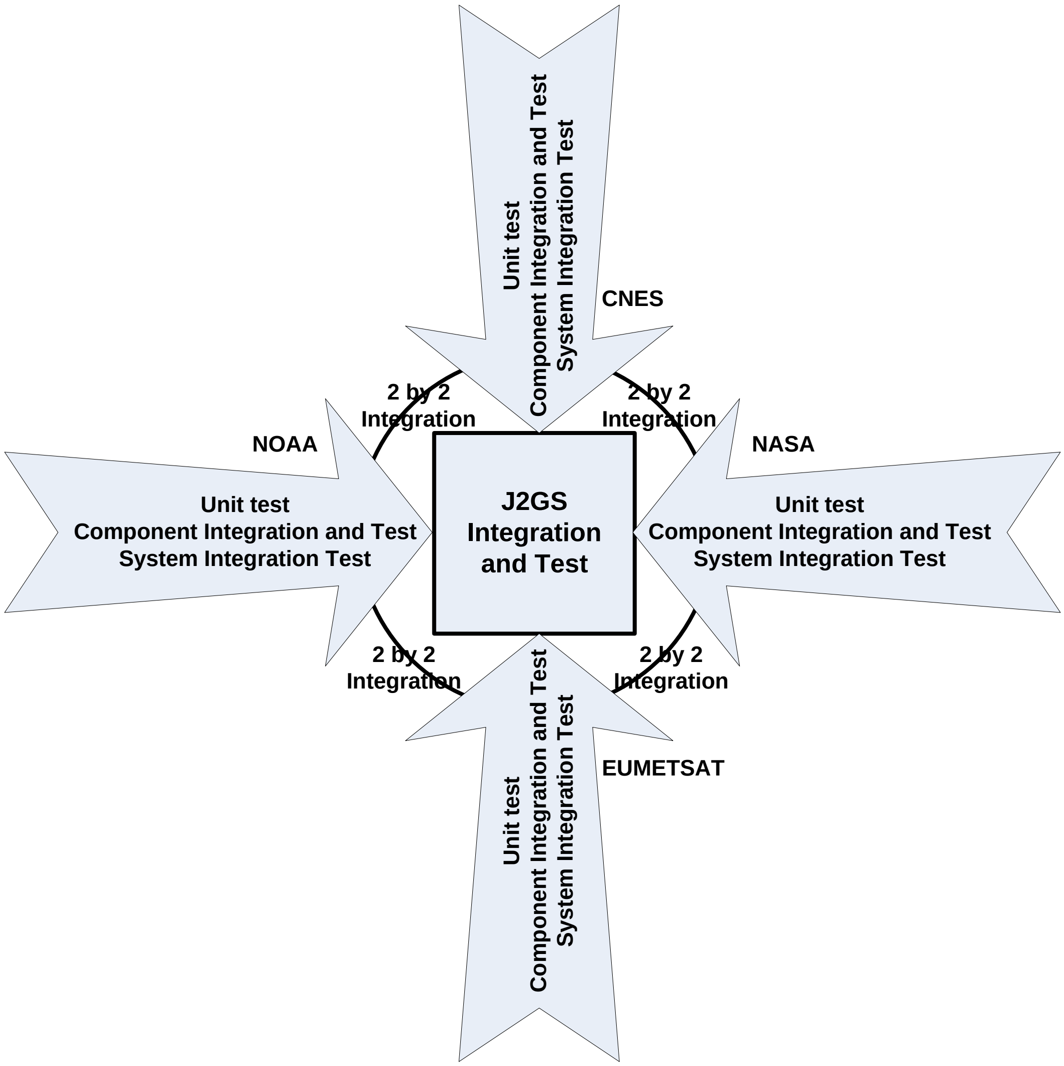
To define and carry out the compatibility and integration tests (aim of the Ground Technical Qualification - GQT phase) a OSTM/JASON-2 GROUND SYSTEM INTERFACES document (AD21) has to be issued. This document will describe all the interfaces between the main elements of the ground system. Once the ground interfaces document (AD21) agreed to each partner will follow these interfaces in the design and implementation of their components. Changes to the ground interfaces document (AD21) will be coordinated with the other affected partners through a Change Request process described in the Configuration Management rules (see AD15).

For the 2 by 2 integration tests a compatibility integration test plans will be established after agreement between two of the partners by following the ground interfaces document (AD21). Each partner will establish its own test procedures.

Compatibility integration tests of the whole OSTM/Jason-2 ground system will be conducted by CNES.

At the end of the GQT Phase all the OSTM/Jason-2 ground system will be validated in term of content structure, connections, transfer protocol and exchanges directories.

The following diagram identifies the level of activities at each partner level and then the integration at the entire system level.



Ground Segment Integration and Testing

As soon as the compatibility tests are performed and the satellite simulator and the satellite database are available the OSTM/Jason-2 ground system functional tests can begin.

The Technical Qualification (QT) Phase is dedicated to functional tests. All the required functions of the OSTM/Jason-2 ground system described in OSTM/JASON-2 GROUND SYSTEM REQUIREMENTS, ARCHITECTURE AND OPERATIONS CONCEPTS (AD4) will be tested and validated till the OSTM/Jason-2 ground system is technically qualified.

The last qualification phase is the Operational Qualification (QO) Phase. In this phase, operational tests will be carried out from the operational procedures. Operations personnel will be trained in how to operate the computers and software of the OSTM/Jason-2 ground system. An Operational Readiness review (ORR) will take place for the beginning of this phase after some major operational tests (like global dress rehearsal for LEOP) and will provide outputs to help to conduct the end of the Operational Qualification. This phase ends with the launch.

The management of all these tests (for instance "Test Readiness Review" meetings before tests and "Post Test Review" meetings after tests) is described in the OSTM/JASON-2 4 PARTNER MISSION ASSURANCE POLICY (AD14).

5.7 CALIBRATION AND VALIDATION

A 4 partner « Calibration/Validation Plan » (AD 9) will be issued with objectives of:

a) definition and assessment of performance goals for all system components, and

b) definition and plans for in flight performance measurement and analysis of accuracy, precision, and drift.

The Calibration/Validation (CALVAL) plan will serve several objectives including:

- The assessment and updating of the system performances in order to verify the pre-launch error budget and to establish the post-launch error budget

- The calibration and validation of all critical geophysical outputs of the system with an accuracy consistent with the error budget including range, corrections, wave height, wind (and possibly sigma naught), and orbit

- The validation/improvement of the algorithms (level 1 and 2) used to produce the geophysical data products

- The determination and control of system drifts (within 1mm/year as a goal)

- The connection between Jason-1 and Jason-2 time series.

4 partner teams, leading by CNES and NASA project offices respectively, will jointly work on these CALVAL tasks in relation with instrument teams, orbit and data production teams, designated experts and the OSTST.

As part of these CAL/VAL activities there are:

- On-site campaigns with sites (Harvest, Corsica, …) equipped with all needed in-situ instruments: tide gages, radiometer, GPS receivers, laser, DORIS data, …

- Global verification, relying on statistical routine analysis, mainly based on daily automated analysis of OGDR and Interim data products, and automated cycle by cycle processing, including histograms, cross-over and along track analysis, mapping and long term survey of main sensor and geophysical parameters.

- Other specific CALVAL activities, proposed by experts or PIs are expected as global external calibration and drift monitoring using tide gage network collocated with DORIS and/or GPS permanent stations. Multi-satellite calibration/validation are also among the other verification procedures which should provide pertinent outputs.

- The Precise Orbit Determination expertise consists in checking the orbit accuracy, characterizing the orbit errors and determining the needed adjustments to reduce it. It will cover the validation of the medium precision satellite ephemeris (MOE) delivered within 1.5-2 days and the precision satellite ephemeris (POE) delivered within 3-4 weeks. The CNES orbit production center will mainly work on statistics, including DORIS, laser, GPS residual analysis (global, station by station statistics, Guier processing) end-to-end orbit and short arc overlaps, cross-over residuals. As for Jason-1, external operational verification is expected in order to check the long term orbit stability, to perform orbit error analysis and to report to the OSTST. This will be based on expertise groups which are already supporting Jason-1 orbit validation activities and which are selected within the OSTST. This has lead to create a POD working team which pre-launch activities will be devoted to the verification of the POD system and GPS processing capabilities, evaluation of improved models and convergence on standards. Post-launch activities will concentrate on comparison of data and orbits during the initial verification phase, continuation of improved models evaluation and final Jason-2 model choice.

The CAL/VAL activities will be maintained through the entire Jason-2 mission in order to ensure a long term monitoring of the system. However, an intense verification period is scheduled during the first 6 months after launch. This verification phase will be used to carefully check the functioning of the system and to assess its performances. During this period, only OGDR, S-IGDR and IGDR will be made available to experts and Pis. A verification workshop at the end of this period will allow to report on the results and to decide about the validity of algorithms used for further GDR processing and about OGDR distribution to users. A second workshop about 10 to 11 months after launch will take place to report on the results for Offline products, to decide about the re-processing tasks and about Offline products distribution to users. The Jason-1/Jason-2 tandem mission during the intense verification phase (the two satellites will be flying on the same orbit only separated by less than 10 minutes) will be particularly useful to cross-calibrate both systems.

The CALVAL plan requires a close interaction among system engineers, data and POD production centers, experts and OSTST. This needs a quick and efficient exchange of data and information between all these key persons. Based on T/P and Jason-1 experiences, regular reports will be provided through e-mails, CALVAL bulletins and at the OSTST meetings.

6. DOCUMENTATION MANAGEMENT

6.1 DOCUMENTATION TREE AND APPROVAL PROCESS

The documentation tree is described in OSTM/JASON-2 4 PARTNER DOCUMENTATION TREE (AD18)

The two documents which give the frame of OSTM/Jason-2 needs and agreements are :

- 4 partner MOU
- OSTM/JASON-2 SCIENCE AND OPERATIONAL REQUIREMENTS

Then the OSTM/Jason-2 documentation is split into 4 main categories:

- Level 1 documents
- System documents
- OSTM/Jason-2 major element documents
- Partner documents

6.1.1 LEVEL 1 DOCUMENTS

Level1 documents are documents which commit the 4 partners in term of :

- organization and tasks
- operational services for products generation, archiving and distribution

OSTM/JASON-2 PROJECT PLAN

Provided by CNES

Signed by : CNES, EUMETSAT, JPL, NOAA

Approved at : JSG level

JASON-2 OPERATIONS SERVICES SPECIFICATION

Provided by CNES

Signed by : CNES, EUMETSAT, JPL, NOAA

Approved at : JSG level

6.1.2 SYSTEM DOCUMENTS

System documents are related to mission documents useful for all the 4 partners in terms of requirements, interfaces, product assurance, configuration management, schedule, mission analysis, tests and operations. These documents will coordinate the 4 partner development and mission phases.

The following system documents are:

Provided by CNES

Signed by : CNES, EUMETSAT, JPL, NOAA

Approved at : Project level

OSTM/JASON-2 SYSTEM REQUIREMENTS

OSTM/ JASON-2 SYSTEM MASTER SCHEDULE

OSTM/JASON-2 4 PARTNER MISSION ASSURANCE POLICY

OSTM/JASON-2 4 PARTNER CONFIGURATION MANAGEMENT POLICY

OSTM/JASON-2 4 PARTNER DOCUMENTATION TREE

OSTM/JASON-2 ENGLISH/FRENCH GLOSSARY OF TERMS AND ACRONYMS

OSTM/JASON-2 SYSTEM TESTS REQUIREMENTS

OSTM/JASON-2 CAL/VAL PLAN

OSTM/JASON-2 MISSION ANALYSIS

JASON-2 SATELLITE TO GROUND INTERFACE SPECIFICATION

OSTM/JASON-2 SYSTEM DATA BASE

RISK REGISTER including :

- CNES RISK REGISTER
- EUMETSAT RISK REGISTER
- NOAA RISK REGISTER
- NASA/JPL RISK REGISTER

OSTM/JASON-2 SPACE DEBRIS MITIGATION PLAN

6.1.3 MAJOR ELEMENT DOCUMENTS

OSTM/Jason-2 major element documents are documents dedicated to one major element of the OSTM/Jason-2 system : Launcher, Satellite and Ground System.

Launcher and Safety:

JASON-2 SPACECRAFT QUESTIONNAIRE

JASON-2 MISSION SPECIFICATION (BOEING MISSION SPECIFICATION)

JASON-2 SAFETY PROGRAM PLAN

JASON-2 MISSILE SYSTEM PRELAUNCH SAFETY PACKAGE

LAUNCH SITE SUPPORT REQUIREMENTS AND LIST

LAUNCH SITE OPERATION PLAN

Satellite :

JASON-2 SATELLITE REQUIREMENTS

JASON-2 SATELLITE ENVIRONMENTAL REQUIREMENTS

SATELLITE / INSTRUMENTS INTERFACES SPECIFICATION

JASON-2 PAYLOAD INTEGRATION AND TEST REQUIREMENTS

SATELLITE ASSEMBLY, INTEGRATION AND TEST (AIT) PLAN

JASON-2 SATELLITE INTEGRATION AND TEST ORGANIZATION

JASON-2 PAYLOAD INSTRUMENTS DELIVERABLES ITEM LIST

Ground System :

OSTM/JASON-2 GROUND SYSTEM REQUIREMENTS, ARCHITECTURE AND OPERATIONS CONCEPTS

OSTM/JASON-2 GROUND SYSTEM INTERFACES

Signature of these documents will be made at project manager level for the concerned partners.

6.1.4 PARTNER DOCUMENTS

Partner documents are related to the internal partner documents. These documents are signed internally by the concerned partner. They can be made available to the other partners as far as interfaces are concerned.

6.2 DOCUMENT DESCRIPTION

The document description is given in OSTM/JASON-2 4 PARTNER DOCUMENTATION TREE (AD18).

6.3 WEB SITE REPOSITORIES AND ACCESS

The System documents (and other documents agreed by the 4 partners) will be available on a OSTM/Jason-2 CNES website as described in OSTM/JASON-2 4 PARTNER CONFIGURATION MANAGEMENT POLICY (AD15).

The access to the documents will be an authorized access managed by login and password.

Description of the document access through the website is given in OSTM/JASON-2 4 PARTNER CONFIGURATION MANAGEMENT POLICY (AD15).

7. CONFIGURATION MANAGEMENT

7.1 RULES AND OBJECTIVES

Configuration management ensures the management of the technical description of a system and its components and of the changes which successively affect this description.

When the Technical Specifications are approved, the actors in the project must implement configuration management for the items of the product under their design responsibility.

The aim of Configuration management is :

- to know, at all times, the technical description of the system and its components by means of approved documentation,
- to control the changes to the technical description of the system,
- to facilitate coherence between the components of the system (control of external interfaces), and the products comprising these components (control of internal interfaces),
- to check that the documentation is and remains an exact reflection of the products that it describes,
- to identify the applicable configuration and the applied configuration in order to deal with deviations and/or waivers detected during the production, delivery or use of the product,
- to enable all users to know the possibilities and utilization limits of each example of the product and, in case of anomalies, the examples affected.

The objective of the Configuration Management (CM) is to be able to easily identify and recreate the operational versions of software. The CM should be able to identify the configuration of the operational hardware. Through the CM processes and tools all the modifications to hardware and software should be recorded and tracked. The CM processes and tools should be able to create any known version of the software and be able to identify the hardware configuration.

For the 4 partners the configuration management policy is described in OSTM/JASON-2 4 PARTNER CONFIGURATION MANAGEMENT POLICY (AD15)

7.2 CONFIGURATION MANAGEMENT TASKS

The four main configuration management tasks are :

The Configuration Identification task: applies to the technical documentation which identifies and describes the approved configuration of a product during the project phases.

The Configuration Control task: concerns the systematic evaluation, the estimation, the approval and the application of change requests relevant to a product the configuration baseline of which has been covered by an official approval.

The Configuration accounting and monitoring task: concerns the recording and the writing of the description of all deviations on a product, between the configuration accepted at a given time and the applied configuration of the product.

The Configuration verification task: includes all control points systematically performed during the phases of the project or in an isolated manner.

7.3 CONFIGURATION MANAGEMENT ORGANIZATION

For the 4 partners the configuration management organization is described in OSTM/JASON-2 4 PARTNER CONFIGURATION MANAGEMENT POLICY (AD15)

The document covers the Configuration management at System level.

Each partner covers its own Configuration management for partner tasks.

CNES will assure the configuration management tasks for System level.

7.4 CONFIGURATION MECHANISMS

For the 4 partners the mechanisms to follow about the configuration management are described in OSTM/JASON-2 4 PARTNER CONFIGURATION MANAGEMENT POLICY (AD15)

At system level Change Requests, Change Requests instruction and Configuration Management boards will be managed as described in AD15.

8. PROJECT REVIEWS

8.1 REVIEW PROCESS DESCRIPTION

The purpose of Project reviews is to assess the completion of Project activities at the end of the phases and all participating agencies within OSTM are committed to conduct review for the elements under their responsibility and support higher level or interfaces reviews.

For each review, the convening authorities shall designate a review board, independent from the project team. The composition of this review board shall be optimized, so as to keep a continuity of the people all along the development of the project but also to adapt it to the dedicated project phase or project element under review. As the OSTM/Jason-2 is a 4 partner project the number of people provided by each partner should not be greater than 3 (more people has to be considered as an exception). As mentioned in the JSG paragraph the convening authorities will also assign steering committees for the system reviews

For system reviews, the review board will be composed of representatives from all agencies. For lower level reviews, the review board is mainly composed of representatives from the agency in charge of the element submitted to review, but participation of representatives from other(s) agencies may be foreseen particularly in the case of tight interfaces.

At the end of each review the designated review board shall gather its findings and recommendations in a report that will be submitted to the steering committee for final decision and identification of precise project actions to be fulfilled with clear assignee(s) and due dates.

The review objectives are to:

(1) Provide the review board with concise information and data sufficient for them to determine if the activity was acceptably accomplished.

(2) Provide information and data sufficient for the review board to recommend adequate decision to the steering committee.

(3) Provide assurance that any activity or decision has satisfied Project requirements and constraints relative to schedule, performance and risk.

Global Statement about the Review process:

Due to the multi agency feature of the programme, there are some deviations from standard way (ECSS, US Handbook, ...) of conducting reviews as presented below.

The standard review process is the following one but it can be adapted to any particular feature of the review. In such a case, this shall be clearly stated in the organization note.

Step 0: Preparation of organization note and review board members designation

Step 1: Presentation of the activity or element and associated documentation under review by the project team to the review board.

Step 2: Release of Review Item Discrepancies (RID's) by the review board to the project

Step 3: Answer to the RID's by the project

Step 4: After analysis of the project answers by the review board and classification of these as acceptable (with or without actions) or not, discussion session between project and review board to try to solve the remaining open points.

Step 5: Preparation of the review board report

Step 6: Steering Committee meeting

A "close out" meeting or telecon will be made to check the proper closure of actions issued from a review

There are three levels of reviews:

Level 1 are system reviews

Level 2 are major element reviews

Level 3 are internal partner reviews or key points

8.2 SYSTEM REVIEWS

System reviews are level 1 reviews.

System reviews are:

1. **System Preliminary Design Review (System PDR)** . The objectives of the System PDR are:
   - to review the compatibility between MOU, Level 1 documents and system documents,
   - to review the system definition consistency with required performances and mission objectives,
   - to validate the system architecture,
   - to assess the System budgets, the preliminary operational concepts, the preliminary items of the System Tests Requirements,
   - to assess if the quality rules are coherent between the partners,
   - to assess the critical points about the development,
   - to analyze the consistency of the system schedule with satellite and ground system elements schedules,
   - to identify and rank project risks.

   The System PDR takes place at the end of the System Phase B.

2. **Ground System Interface Review (SIR**) . Although it is restricted to the ground system interfaces and development status, the SIR has been included in the System Reviews because of the strong involvement of all the 4 partners in the ground system. The main objectives of the SIR are:
   - to review the ground system interfaces detailed definition,
   - to review the status of development of all the ground entities,
   - to verify the proper preparation of the Mission Operations in terms of documentation, tools and resources.

   The SIR takes place at the end of the System Phase C and before the Technical Ground Qualification (GQT) phase.

3. **Operational Readiness Review (ORR) .** The objective of the ORR is to demonstrate the Ground System readiness to operate for all mission phases : LEOP, assessment, routine. This includes :
- to demonstrate that the OSTM/Jason2 Ground System can safely operate the satellite and adequately react in case of contingency
- to demonstrate that the OSTM/Jason2 Ground System can elaborate and distribute the science products according to the system requirements
- to demonstrate the OSTM/Jason2 Ground System readiness for the System qualification during "In Flight Acceptance" phase
- to show the organization of Operation teams (people, hardware, etc, ..) at CNES,EUMETSAT, NOAA and JPL to ensure the OSTM mission
- for each OSTM/Jason2 Ground System element to give the status of the :
  - interfaces qualification
  - functional qualification
  - operational qualification
- to ensure that the status of the documentation is adequate for operations
- to ensure that the configuration management is operational (Anomalies, Change Requests, ...) for the mission
- to ensure that appropriate plans are in place for maintenance of on board software and satellite simulators

The ORR takes place during the QO phase, and about 2 to 3 months before launch, in order to give some time to implement before launch the actions and corrections as required by the Review Board.

4. **Satellite Operations Handover Review.** The objectives of the Satellite Operations Handover Review are:
- to verify that the NOAA & CNES OSTM/Jason-2 mission operations elements have met the following criteria for the Project to transfer mission control responsibility for the Jason-2 satellite from CNES to NOAA

Criteria are :
  - Satellite must be in Routine phase: in the operational orbit, in Nominal AOCS and CC mode.
  - CNES and NOAA must have agreed on all flight control procedures to be used by NOAA in the operation of the satellite.
  - CNES must have provided approved versions of all required operational documentation to NOAA: satellite users manual, satellite interface documents, ground and operations interface documents, sequence plans, flight control procedures.
  - NOAA must have demonstrated the ability to command the satellite and receive telemetry data after launch using both the NOAA stations and EUMETSAT Earth Terminal
  - NOAA must have demonstrated the ability to perform normal mode operations including sequence generation, satellite commanding, TM product generation, anomaly responses.
  - NOAA and CNES must have demonstrated the ability to generate and transfer all required J2GS products to each other.
  - NOAA and CNES must have exercised all operational interfaces.

The Satellite Operations Handover Review takes place two months after the start of the operational phase.

5. **Near Real Time Product dissemination Workshop (*) .** The objectives of this workshop are to assess the validation of the Near Real Time (NRT) products and to authorize the delivery of these products to the users .
It takes place 5 months after the beginning of the Verification Phase.

6. **Off Line Product dissemination Workshop (*) .** The objectives of this workshop are to assess the validation of the Offline (OFL) products and authorize their release to the users.
It takes place at the end of the Verification Phase.

7. **REVEX (yearly operation review) .** The objectives of the REVEX are:
- to evaluate the suitability of the board and the ground means to satisfy the mission objectives in routine phase,
- to establish recommendations about the change requests to implement in the different components in

order to improve the system efficiency or/and the satellite lifetime.

The REVEX reviews take place once per year, beginning one year after the Satellite Operations Handover Review.

(*** -** Workshops are reviews meetings generally gathered with OSTST meetings)

"System reviews" review board:

CNES is the convening authority for System Reviews and as such is coordinating the review process as described above. Before Satellite Operations Handover NASA and CNES will co-chair the Review Board. After Satellite Operations Handover, EUMETSAT and NOAA will co-chair the Review Board.

The system review board shall nominally be composed of representatives of the four agencies working on OSTM, the precise composition depending upon the review.

The steering committee of the system review is the JSG where the review board chairman is invited to present the review group report.

Taking into account the results of the relevant reviews, the Partners will jointly:

a. Make a final determination of the system readiness for operations (JSG as Steering Committee of the Operational Readiness Review - ORR) ;

b. Make a final determination on the readiness of the satellite for integration with the launch vehicle (JSG following the Satellite Readiness Review - SRR – see section 8.3) ; and

c. Make a final determination of the overall readiness of the system for launch (JSG following the Flight Readiness Review - FRR – see section 8.3).

8.3 MAJOR ELEMENT REVIEWS

Major element reviews are level 2 reviews.

A major element of the OSTM/Jason-2 system is :

- Launcher
- Satellite
- Ground System

as defined in the OSTM/JASON-2 4 PARTNER DOCUMENTATION TREE (AD18).

For each major element, the agency in charge of the development, testing and /or operation of this element is in charge of the coordination, scheduling, and organization of the element reviews.

Basically, the process applied to those reviews is the same as for the system reviews, but may be simplified according to the level/criticality of the element or modified to better cope with in house or contractor standard.

Each agency is committed to invite the other agencies to participate (in accordance with any applicable government laws relating to foreign nationals participation) to its element's reviews but no board membership in the review board is offered. The review board members designation as well as the steering committee is the responsibility of the provider of the element.

Nevertheless, for each element review, a synthesis of the results of the review shall be sent to all project managers, to the members of the system review boards and to the JSG members for their information.

In the specific case of interface reviews between two or more elements of the system being developed by more than one agency (e.g. satellite/launcher interfaces), the two agencies will organize the review and propose membership to the review board.

For Satellite major element reviews are :

Satellite PDR (at the end of satellite phase B)

Satellite CDR(at the end of satellite phase C)

Satellite Qualification Review (after completion of environmental test and performance test sequence)

Satellite Pre ship Review (before the satellite shipment to launch facilities)

Satellite Readiness Review (after satellite checking and preparation activities on launch site before mating on launch vehicle)

End of Assessment phase Meeting

For Ground System major element reviews are :

Global Test Readiness Meetings (TRR) (before each main test and qualification phase : QT phase and QO phase)

For Launcher major element reviews are :

Launch Site Readiness Review (LSRR) (approximately Launch-14 days)

Flight Readiness Review (FRR) (Launch-3/4 days)

Launch Readiness Review (LRR) (Launch-1 day)

8.4 INTERNAL PARTNER REVIEWS OR KEY POINTS

Internal Partner Reviews are reviews organized internally by each partner about one of the element that it has to provide. Each partner will follow its internal rules for the review. The review board members designation as well as the steering committee is the responsibility of the provider of the element.

An Internal Partner Key Point is a meeting dedicated to one element without the review formalism.

Each partner has to inform the other partners about the occurrence of Internal Partner Review or Internal Partner Key Point. Each partner can invite other partners to attend the Review or the Key Point.

Nevertheless, at least, a synthesis of the results of the review or the key point shall be presented or sent to all project managers.

Example of internal partner review :

Instrument PDR

Instrument CDR

…

9. PROJECT SCHEDULE

9.1 SCHEDULE ELABORATION AND MANAGEMENT

9.1.1 SYSTEM SCHEDULE:

The bookkeeper of the system schedule will be the CNES system responsible. The system schedule will be composed of pieces of elements (flight/ground/system) schedule. For each of these element schedules, a single responsible will be designated and in charge of providing the detailed sub-levels schedule supporting the element schedule. It is the responsibility of the CNES system responsible to ensure coherency/consistency of the various inputs when building the system schedule. The system schedule is updated for the reviews or when modifications of the element schedule impacts system milestones. Any modification at system level which potentially impact the launch date shall be brought to the JSG.

9.1.2 ELEMENT SCHEDULES:

These are the element schedules aiming at building the system schedule. Their responsibility remains within the agency in charge of developing/integrating or testing the element. As long as modifications of any of the element schedule do not impact the system schedule, these modifications remain under the element responsibility level. On the other hand, if it appears that a modification may affect the system level schedule, this has to be brought to the system responsible in order for him to assess the impact at system level. Element schedules are updated for element reviews and on a continuous basis to reflect changes.

9.1.3 TOOLS:

The tool to be used for transferring/exchanging the schedule between the various levels is MS Project (issue 2000 or higher)

9.1.4 SCHEDULE RESPONSIBILITIES:

ELEMENT	RESPONSIBLE		ELEMENT	RESPONSIBLE
System	CNES		Ground System	CNES
Satellite	CNES		Upgrade CCC	CNES
Altimeter	CNES		Upgrade SOCC	NOAA
DORIS	CNES		Upgrade CDA	NOAA
AMR	JPL		Upgrade Archive System	NOAA
GPSP	JPL		EUM ET	CNES
LRA	JPL		EUM ET infra	EUMETSAT
T2L2	CNES		EUM ET integration	EUMETSAT
CARMEN2	CNES		Upgrade SSALTO	CNES
LPT	CNES		NRT processing	CNES
Payload AIT	CNES		NRT integration at NOAA	NOAA
Satellite AIT	CNES		NRT integration at EUM	EUMETSAT
Launch Campaign	CNES+NASA		GQT	Each agency for the element under its responsibility
SDB	CNES		QT	CNES
			QO	CNES
			In flight assessment	CNES

Schedules will be sent to CNES on a monthly basis and at any time if needed.

A System master schedule will be available every two months nominally and more often if needed by the 4 project managers

10. REPORTING AND MANAGEMENT PROCESS

10.1 REPORTING

Each agency will use its own internal reporting procedure as described in their own management plan.

At system level, a periodic reporting shall be made to the upper management, which in this case will be the JSG.

This reporting will be made every 6 month, which will mean, assuming one JSG meeting per year, that the members of the JSG will receive one system report in between the yearly meeting.

The CNES will be in charge of the coordination of the preparation and release of this document with contributions coming from the partners for the elements under their responsibility.

The system report shall at minimum include:

- A short summary of the main progress/milestones achieved in the program development.
- Details on any open issue and their potential impact on performance/schedule/cost
- An update of the each partner project risk register
- An updated system schedule (if modified since the last release of the report)
- Any major update on project organization or key personnel
- A short summary of outreach activities

10.2 ACTION ITEM MANAGEMENT

Action item lists will be managed and updated between 2 partners through dedicated partner telecons (see the Project Teams Interactions paragraph).

Four partner action item list will be managed by CNES and updated through the 4 partner interactions described in the Project Teams Interactions paragraph.

There are no constraints about the tools used for managing action item list.

10.3 PROJECT TEAMS INTERACTIONS

In order to facilitate the communication among the partners, all means of interaction shall be used.

This includes but is not limited to:

- In line Project documentation and tools
- Web site access for project system lists (anomalies, change request…)
- Web site access for review documents and process (RID's, answer, Recommendations..)
- Use of bilateral and 4 partners telecon and videocon as needed
- Periodic face to face meeting or when a dedicated subject so requires

Four partner progress meetings could also be planned on a yearly basis nominally and more often if needed

Exchange of personnel can also be planned. This efficient way shall be used among the partners particularly with the objective to prepare and facilitate the process of integration of an element from one partner to another one (e.g. delivery of instruments, preparation of AIT, preparation of operation or hand-over).

10.3.1 SATELLITE AND INSTRUMENTS LEVEL

Telecons will take place every week between JPL and CNES until JPL instrument delivery.

An action item list will be managed between the CNES and JPL payload managers.

Periodic face to face meeting will be organized at least on a biyearly basis.

10.3.2 GROUND SYSTEM LEVEL

Telecons will take place every two weeks between NOAA, EUMETSAT and CNES (JPL can also attend these telecons).

An action item list will be managed between the CNES, NOAA and EUMETSAT ground managers..

Periodic face to face meeting will be organized at least on a biyearly basis.

10.3.3 4 PARTNER MANAGEMENT LEVEL

At 4 partner project manager level telecons will take place every two weeks between NOAA, EUMETSAT, JPL and CNES to address at least the following points :

- Main progress/milestones achieved in the partner development
- Partner risk register update
- Partner schedule evolutions
- Details on any open issue and its potential impact on the system performance/schedule

A 4 partner action item list will be managed.

CNES will lead the telecons and manage and maintain the risk register, master schedule and action item list

11. MANAGEMENT OF HARDWARE AND SOFTWARE DELIVERED BETWEEN PARTNERS

According to the MOU hardware and software can be delivered between the partners.

Each Partner will retain ownership of elements and equipment it furnishes to another Partner, except as otherwise agreed.

Any equipment not launched into space will be returned to the furnishing Partner at such time as mutually agreed, unless otherwise agreed.

Each Partner will transport its equipment to the delivery points, as specified in the deliveries documents, and, where appropriate, from such delivery points, when the equipment is to be returned to the furnishing Partner.

11.1 "CNES TO NASA" AND "NASA TO CNES" DELIVERIES

The detailed deliveries planned between CNES and NASA are described in the following documents :

- MOU (RD1)
- TECHNICAL ASSISTANCE AGREEMENT BETWEEN CALIFORNIA INSTITUTE OF TECHNOLOGY (CALTECH) AT NASA'S JET PROPULSION LABORATORY (JPL) AND CENTRE NATIONAL d'ETUDES SPATIALES (CNES) – date : Feb 12, 2004
- JASON-2 PAYLOAD INSTRUMENTS DELIVERABLES ITEM LIST (AD3).
- LETTER OF AGREEMENT BETWEEN NASA AND CNES- date : Aug 1, 2005 which covers the delivery of a PROTEUS Platform Interface Simulator (PPIS) and a breadboard of the Traveling Wave Tube Amplifier (TWTA).

11.2 "CNES TO NOAA" AND "NOAA TO CNES" DELIVERIES

The detailed deliveries planned between CNES and NOAA are described in the following documents :

- MOU (RD1)
- OSTMJASON-2: CNES/NOAA DELIVERABLES ITEM LIST (AD6)

As a main delivery CNES will deliver to NOAA a Near Real Time processor (software, documentation and training) for OGDR production and a Data Remote Processing PC (DRPPC) as a validation tool. CNES will handle the maintenance of the NRT processing system.

11.3 "CNES TO EUMETSAT" AND "EUMETSAT TO CNES"DELIVERIES

The detailed deliveries planned between CNES and EUMETSAT are described in the following documents :

- MOU (RD1)
- OSTMJASON-2: CNES/EUMETSAT DELIVERABLES ITEM LIST (AD5)
- CNES-EUMETSAT COOPERATION AGREEMENT (RD2)

As a main delivery CNES will deliver to EUMETSAT elements of the Earth Terminal, a Near Real Time processor (hardware, software, documentation and training) for OGDR production and a Data Remote

Processing PC (DRPPC) as Earth Terminal monitoring tool. CNES will handle the maintenance of the NRT processing system.

11.4 "NASA TO NOAA" AND "NOAA TO NASA"DELIVERIES

The detailed deliveries planned between NASA and NOAA are described in the following documents :

- MOU (RD1)
- OSTMJASON-2: NASA/NOAA DELIVERABLES ITEM LIST (AD12)

The major delivery by NASA to NOAA is the software and documentation for JASON-2 Telemetry, Command, and Communications Subsystem (J2TCCS).

12. ANNEXES

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DOCUMENTATION CHANGE RECORD

Issue.	Rev.	Dates	Pages	Modifications	Visa
0	0	Sep 1, 2005	All	Preliminary issue for comments	
0	1	Nov 21, 2005	All	Preliminary issue with partners comments	
0	2	Nov 29, 2005	All	New issue with all the sections	
0	3	Dec 1, 2005	All	New issue for PDR preparation telecon	
1	0	Dec 7, 2005	All	First issue for System PDR	
1	1	Jan 30, 2006	All	Modifications according to System PDR recommendations – rev 1	
1	2	Feb 9, 2006	All	Modifications according to partners comments	

DIFFUSION

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DIFFUSION CNES			
Noms	**Sigles**	**Bpi**	**Ex.**
BOURDEIL M.	DCT/AQ	1411	
LABRUNEE M.	DCT/AQ	1411	
LACROIX D.	DCT/AQ	1411	
CHIAVASSA F.	DCT/AQ/CQ	1412	
LAY Ph.	DCT/AQ/CQ	1412	
BEZERRA F.	DCT/AQ/EC	1414	
ECOFFET R.	DCT/AQ/EC	1414	X
LORFEVRE E.	DCT/AQ/EC	1414	X
VENTURIN J.	DCT/AQ/EC	1414	
ETIENNE J.	DCT/AQ/GP	2513	
ROMAN V.	DCT/AQ/GP	2513	X
VERLET E.	DCT/AQ/GP	2003	
PRESSECQ F.	DCT/AQ/LE	1414	
DURIN C.	DCT/AQ/MP	1413	
LAUTIER E.	DCT/AQ/QP	1415	X
MARTIN A.	DCT/AQ/QP	1415	
MARTIN Ch.	DCT/AQ/QP	1415	X
TONDU A.	DCT/AQ/QP	1415	X
DEDE G.	DCT/AQ/SF	1413	
LAULHERET R.	DCT/AQ/SF	1413	X
VERGNAULT E.	DCT/AQ/SF	1413	X
MOSKWA P.	DCT/D	2521	
CAZAUX C.	DCT/IB	2222	
CROS P.	DCT/IB/2I	2532	
ESCARNOT J.	DCT/IB/2I	2222	
HOZE P.	DCT/IB/2I	2003	
TRIBES R.	DCT/IB/2I	2504	X
GRIMBERT A.	DCT/IB/IL	2222	
CAMPAN G.	DCT/OP	1211	
CABRIERES B.	DCT/OP	1211	
POULIQUEN C.	DCT/OP	1211	
CORCORAL N.	DCT/OP/M2	3406	X
CREBASSOL Ph.	DCT/OP/M2	3406	X
LODS P.	DCT/OP/M2	3406	
COUTURE D.	DCT/OP/MO	1213	

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BERGES D.	DCT/OP/MR	1215	X
MONGIS J.	DCT/OP/MR	1215	
CARRIERE A.	DCT/OP/SOL	3407	
JOUAN C.	DCT/OP/SOL	3407	X
MARLE M.	DCT/OP/SOL	3407	
POBLE JF	DCT/OP/SOL	3407	X
CARLIER A.	DCT/OP/SR	1216	
DE BEAUMONT O.	DCT/OP/SR	1216	
GOUDY Ph.	DCT/PO	2524	
AURIOL A.	DCT/PO/AL	2002	
BELLEFOND N.	DCT/PO/AL	2002	
COUTIN-FAYE S.	DCT/PO/AL	2002	
DEJUS M.	DCT/PO/AL	2002	
GRANIER JP.	DCT/PO/AL	2002	X
JAYLES C.	DCT/PO/AL	2002	
LAFON T.	DCT/PO/AL	2002	X
MALECHAUX M.	DCT/PO/AL	2002	X
NOUBEL J.	DCT/PO/AL	2002	X
PERBOS J.	DCT/PO/AL	2002	X
PETITBON I.	DCT/PO/AL	2002	X
PICOT N.	DCT/PO/AL	2002	X
SENGENES P.	DCT/PO/AL	2002	X
TAVERNIER G.	DCT/PO/AL	2002	
ZAOUCHE G.	DCT/PO/AL	2002	X
SARAPOFF C.	DCT/PO/GP	2502	
SERGUE E.	DCT/PO/GP	2502	
THOMAS P.	DCT/PO/GP	2502	
BLOUVAC J.	DCT/PO/MI	2532	
JOURET-PERL M.	DCT/PO/MI	2532	
LANDIECH Ph.	DCT/PO/MI	2532	X
LEDU M	DCT/PO/MI	2532	
ROLFO A.	DCT/PO/MI	2532	
TARRIEU C.	DCT/PO/MI	2532	
VIENNE D.	DCT/PO/MI	2532	X

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BOY F.	DCT/PS/CMI	1501	
GUINLE T.	DCT/PS/CMI	1501	X
VIDAL D.	DCT/PS/CMI	1501	
COUDERC V.	DCT/PS/SSC	1522	X
GELIE P.	DCT/PS/SSC	1522	X
LABRUNE Y.	DCT/PS/SSC	1522	
LAFITTE P.	DCT/PS/SSC	1522	X
LAFUMA P.	DCT/RF	2512	
LEMAGNER F.	DCT/RF/AN	3602	
BOUYER Y.	DCT/RF/BF	2512	
MEENS V.	DCT/RF/BF	2512	
PLA J.	DCT/RF/BF	2512	
BOULANGER C.	DCT/RF/HT	2013	
GUILLEMOT P	DCT/RF/HT	2013	X
LUVISUTTO E.	DCT/RF/HT	2013	
BENOIST J.	DCT/RF/IF	2012	X
GRONDIN M.	DCT/RF/IR	2013	
RAIZONVILLE Ph.	DCT/RF/IR	2013	
ROBERT E.	DCT/RF/IR	2013	
NABET G.	DCT/RH	1621	
ARBERET P.	DCT/SB/LV	2525	
LE GUEN Y.	DCT/SA	222	
LEPAROUX Ph.	*DCT/SA/AB*	1605	
VIC-HERNANDEZ M.	DCT/SA/AB	1605	
BLAIGNAN G.	DCT/SA/SI	2401	
PECHMALBEC S.	DCT/SA/SI	2401	X
JULIA G.	DCT/SA/SI	2401	
MARCHAL Ph.	DCT/SB	1421	
DELATTE B.	DCT/SB/BS	1712	
LABORDE G.	DCT/SB/BS	1712	
TOURRAILLE J.M.	DCT/SB/BS	1712	X
CAZAUX JM.	DCT/SB/CC	2214	

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MESNAGER J.M.	DCT/SB/CC	2214	X
PICART G	DCT/SB/CC	2214	
SCHAFFHAUSER F.	DCT/SB/CC	2214	X
TOULOUZE P	DCT/SB/CC	2214	
JULIEN E.	DCT/SB/MP	2527	
LASSALLE-BALIER G.	DCT/SB/MP	2527	
TYROU V.	DCT/SB/MP	2527	X
FRAYSSE H.	DCT/SB/MS	1324	
GAMET Ph.	DCT/SB/MS	1324	
PRADINES D.	DCT/SB/MS	1324	X
SALCEDO C.	DCT/SB/MS	1324	X
BERRIVIN S.	DCT/SB/OI	1214	
DUFOUR F.	DCT/SB/OI	1214	
HOURY S.	DCT/SB/OR	1323	X
MERCIER F.	DCT/SB/OR	1323	X
VAN TROOSTEN-BERGHE P.	DCT/SB/OR	1323	
PELIPENKO P.	DCT/SB/PS	1712	
TELLO M.	DCT/SB/PS	1712	X
AVIGNON M.	DCT/SI	1711	
CARAYON G.	DCT/SI/AR	2101	X
COURRIERE JL.	DCT/SI/AR	2101	X
STEUNOU N.	DCT/SI/AR	2101	X
MARTINUZZI J.	DCT/SI/IM	2111	
LAMBIN J.	DCT/SI/IM	2111	X
CUGNY B.	DCT/SI/IR	2101	
CAZENAVE A.	DCT/SI/LG	3200	
MENARD Y.	DCT/SI/LG	3200	X
GASC K.	DCT/SI/OP	3601	X
BOLOH L.	DCT/TV	1416	
LOUBEYRE J.Ph.	DCT/TV/AV	1713	
VINCENDET C.	DCT/TV/AV	1713	
FREDON S.	DCT/TV/EL	2213	
MASSOT J.	DCT/TV/EL	2213	
PANH J.	DCT/TV/EL	2213	

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DIFFUSION CNES			
Noms	**Sigles**	**Bpi**	**Ex.**
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TASTET P.	DCT/TV/EL	2213	
GUAY Ph.	DCT/TV/MS	1715	
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OSTM/Jason-2 Project Plan

DIFFUSION Alcatel Alenia Cannes		
Noms	**Sigles**	**Ex.**
Documentation Projet	*Cyndie.Voterski@support-externe.alcatelaleniaspace.com* ***ET*** ***Jeanne-Chantal.Daguzan@alcatelaleniaspace.com***	
HUIBAN T.	*AASC*	
TERRENOIRE Ph.	*AASC*	

DIFFUSION EREMS		
Noms	**Sigles**	**Ex.**

DIFFUSION OCA		
Noms	**Sigles**	**Ex.**
SAMAIN E.	*OCA*	

DIFFUSION Alcatel Alenia Toulouse		
Noms	**Sigles**	**Ex.**
CAUBET E.	*AAST*	
PHALIPPOU L.	*AAST*	
Bois Stéphanie: (Stephanie.Bois@alcatelaleniaspace.com)	*AAST Documentaliste*	

DIFFUSION SESO		
Noms	**Sigles**	**Ex.**
BONNEVILLE Ch.	*SESO*	

DIFFUSION CLS		
Noms	**Sigles**	**Ex.**
DORANDEU J.	*CLS*	
ESCUDIER Ph	*CLS*	
LOAEC M.N.	*CLS*	
NHUN FAT B.	*CLS*	
ESCUDIER Ph	*CLS*	
ZANIFE O.Z.	*CLS*	

DIFFUSION EREMS		
Noms	**Sigles**	**Ex.**
LE BARATOUX L.	*EREMS*	

DIFFUSION

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OSTM/Jason-2 Project Plan

DIFFUSION JAXA		
Noms	**Sigles**	**Ex.**
GOKA T.	*JAXA*	X
KOMIYAMA T.	*JAXA*	
MATSUMOTO H.	*JAXA*	

DIFFUSION JPL		
Noms	**Sigles**	**Ex.**
ABID M.	*JPL*	X
AGRAWAL A.	*JPL*	
FU L.	*JPL*	X
VAZE P.	*JPL*	X
WIRTH J.	*JPL*	

DIFFUSION NOAA		
Noms	**Sigles**	**Ex.**
BANNOURA W.	*NOAA*	X
LILLIBRIDGE J.	*NOAA*	X
WADE A.	*NOAA*	X

DIFFUSION EUMETSAT		
Noms	**Sigles**	**Ex.**
BONEKAMP H.	*EUM*	X
FAUCHER D.	*EUM*	X
PARISOT F.	*EUM*	X
WANNOP S.	*EUM*	X
ZARZA R.	*EUM*	X

DIFFUSION NASA		
Noms	**Sigles**	**Ex.**
NEECK S.	*NASA*	X

INDEXED NOTE

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ANNEX C

NASA KSC / Analex Corporation

Expendable Launch Vehicle Integrated Services (ELVIS) Contract Statement of Work (SOW)

ANNEX C: ELVIS Statement of Work (SOW)

This is the NASA Expendable Launch Vehicle Integration Services (ELVIS) contract Statement of Work (SOW), that has only the work performed by Analex Corporation under the contract in support of the NASA Launch Services Program Office for the Ocean Surface Topography Mission (OSTM).

1 Safety

Analex shall perform systems safety assessments, procedure reviews, and operations surveillance of spacecraft contractor design, integration, and test activities to ensure the identification and assessment, and elimination, or control of hazards.

1.1 Systems Safety Assessments

Analex shall perform system safety assessment of mission unique design, integration, test activities, and launch preparations. Analex shall participate in the tailoring of applicable safety requirements. Analex shall review and provide assessment of Spacecraft and Expendable Launch Vehicle (ELV) Missile System Pre-launch Safety Packages (MSPSP) or equivalent documents, variance requests, and design changes.

1.2 Procedure Reviews

Analex shall review all integrated procedures classified as hazardous to ensure hazardous operations are identified and appropriate safety precautions are implemented. In both cases, Analex shall assess all non-hazardous procedures to ensure proper classification.

1.3 Safety Surveillance and Support of Operations

Analex shall perform safety surveillance and assessments of all hazardous operations for NASA and Non-NASA missions when processing takes place on NASA property or within a NASA facility. Analex shall perform safety surveillance of all NASA mission integration activities that are classified as hazardous and are being performed on Launch Service Provider (LSP) property or within a Launch Service Provider (LSP) facility.

1.4 Participation in Meetings, Reviews, and Working Groups

Analex shall participate in NASA, Launch Service Provider (LSP) and spacecraft contractor, meetings/reviews including, status meetings, Technical Interchange Meetings, Design Reviews, Phase Safety Reviews, Payload Safety Working Groups, and Ground Operation Working Groups for NASA missions and other processing operations in NASA's assigned facilities.

1.5 Safety Training

Analex shall develop and conduct safety training including all required facility access/safety training for all NASA customers, NASA transient/resident, and contractor personnel for each NASA mission.

1.6 Quality Surveillance of Launch Service Provider (LSP)

Analex shall provide surveillance at all manufacturing, processing, testing, and launch site locations. Analex shall participate in local reviews, meetings, pertinent tests and local site visits.

1.7 Design Reviews

Analex shall participate in Preliminary Design Reviews (PDR), Critical Design Reviews (CDR), and Design Certification Reviews (DCR), Mission Unique Requirements Reviews (MURR), Mission Unique Preliminary Design Reviews (MUPDR), and Mission Unique Critical Design Reviews (MUCDR). Analex shall review and provide technical assessment of Design restrictions, limitations and known violations including system safety, hardware and software.

1.8 Production Reviews

Analex shall participate in Hardware Acceptance Reviews (HAR), Pedigree Reviews, Production Reviews, and Pre-Vehicle-On-Stand Reviews (Pre-VOS). Analex shall review and provide technical assessments on any build paper, test results, non-conformance reports, discrepancy history, failure analysis, waivers, deviations, and MRB's presented at reviews.

1.9 NASA Launch Readiness Reviews

Analex shall attend Pre-Launch Readiness reviews (LRR and FRR) and launch activities.

2 Launch Site Support Engineering

Analex shall work with the NASA Launch Site Integration Manager (LSIM) for all ground processing mission activities and provide launch site support documentation, launch site operational services, launch operations management support, and launch site administrative services. The NASA Launch Site Integration Manager (LSIM) is the primary interface and Analex is the secondary interface. Analex shall represent the NASA Launch Site Integration Manager (LSIM) position at meetings, teleconferences, design reviews, technical interchange and working group meetings when the NASA Launch Site Integration Manager (LSIM) cannot attend.

Analex shall be the point of contact (POC) between spacecraft projects and other organizations including the Eastern Range (ER) and the Western Range (WR), Government/Commercial Payload Processing Facility (PPF)s, and Launch Service Provider (LSP)s.

2.1 Launch Site Documentation Services

Analex shall provide launch site documentation services.

Analex shall gather all documentation requirements from the payload customers by direct communication and through attendance to spacecraft and Launch Service Provider (LSP) meetings. Analex shall travel to the meetings if not held locally possibly involving foreign travel. These meetings include, but are not limited to the following: Project Kick-Off Meeting, Preliminary Design Review, Critical Design Review, Mission Integration Working Group meetings and teleconferences, Ground Operations Working Group meetings and teleconferences, Technical Interchange meetings, Pre-Ship review meetings. Launch Site Readiness Review, Flight Readiness Review, Launch Readiness Review. Analex shall use the information gathered and provide documentation services.

2.2 Launch Site Support Plan (LSSP)

Analex shall coordinate with payload customers in the identification, definition, and documentation of their requirements in the Launch Site Support Plan (LSSP). Analex shall publish and distribute preliminary and baseline versions of the Launch Site Support Plan (LSSP) with revisions as necessary. Analex shall catalog and incorporate changes to the Launch Site Support Plan (LSSP) and conduct detailed reviews with the payload customer in order to refine the document.

2.3 Program Introduction (PI) document for the Range

Analex shall coordinate with payload customers in the identification, definition, and documentation of their requirements in the Program Introduction (PI) document and submit to the Range.

2.4 Program Requirements Document (PRD) for the Range

Analex shall coordinate with payload customers in the identification, definition, and documentation of their requirements in the Program Requirements Document (PRD) for the Range.

2.5 Spacecraft Mission Operations Requirements (OR) document for the Range

Analex shall provide input to the Launch Service Provider (LSP) in the writing of the mission Operations Requirements (OR) document for submittal to the Range. Analex shall use the Launch Site Support Plan (LSSP) and Program Requirements Document (PRD) as well as further input from the NASA Launch Site Integration

Manager (LSIM) and the payload customer to define and develop specific spacecraft inputs for the Launch Service Provider (LSP)-developed mission Operations Requirements (OR). Analex shall work closely with the Launch Service Provider (LSP) writer of the Operations Requirements (OR) to input these requirements. Analex shall review draft and published copies of the Operations Requirements (OR) for correctness. Analex shall modify Operations Requirements (OR) input as required.

Analex shall prepare the spacecraft Operations Requirements (OR) document for payloads processed in NASA and commercial Payload Processing Facilities (PPF). Analex shall use the Launch Site Support Plan (LSSP) and Program Requirements Document (PRD) as well as further input from the NASA Launch Site Integration Manager (LSIM) and the payload customer to develop a spacecraft-specific spacecraft Operations Requirements (OR) for spacecraft processing support in a Payload Processing Facility (PPF). Analex shall modify the spacecraft-specific spacecraft Operations Requirements (OR) as required.

2.6 Safety Advisory Function

Analex shall review customer requirements and advise the payload customer in safety planning including, but not limited to the following areas of facility requirements and modifications: mechanical, electrical, communications, contamination control, office space, telephones, base access and security.

Analex shall provide safety advice to the payload customer for the preparation the Missile Systems Pre-Launch Safety Package (MSPSP).

2.7 Review of Launch Service Provider (LSP)/Range-Provided Documentation

Analex shall review the Launch Service Provider (LSP) spacecraft Interface Control Document (ICD) and spacecraft questionnaire for completeness and accuracy of spacecraft requirements. Analex shall submit comments to the Launch Service Provider (LSP) after concurrence with the NASA Launch Site Integration Manager (LSIM).

Analex shall review and provide comments to the NASA Launch Site Integration Manager (LSIM) on Range-authored support documentation to ensure the Range properly addresses all customer requirements. This documentation shall include, but not be limited to the following:

- Statement of Capability (SC), which is the Range response to the Program Introduction (for Vandenberg Air Force Base (VAFB) missions only)
- Program Support Plan (PSP), which is the Range response to the Program Requirements Document
- Operations Directive (OD), which is the Range response to the Operations Requirements Document
- Network Implementation Plan (NIP), which is the Range launch day communications implementation plan
- Integrated Communications Requirements Document (ICRD), which is a communications annex to the Operations Requirements (OR) document

2.8 Launch Site Integration Operational Services

Analex shall perform the operational support tasks in coordination with the NASA Launch Site Integration Manager (LSIM).

2.9 Payload Transportation

Analex shall coordinate security escorts, and coordinate support from US Customs, Immigration and Agriculture Department for foreign payloads.

2.10 Payload Operations in the Payload Processing Facility (PPF)

Analex shall coordinate the review of payload customer test plans and technical operational procedures and track their approval status.

Analex shall perform the following tasks for payload operations in the NASA Payload Processing Facility (PPF)s:

- Distribute keys/combinations
- Coordinate facility and safety training
- Coordinate shipping and receiving services
- Coordinate access lists and guard orders
- Maintain a spacecraft activities log book
- Coordinate the procurement and use of consumables, supplies and materials
- Coordinate and schedule support for fueling operations
- Coordinate delivery radiation sources with the USAF
- Coordinate storage of pyros and radiation sources
- Coordinate photo support from the USAF
- Be cognizant of payload activities and reschedule support in response to anomalies and changes in plans

2.11 Payload Operations at the Launch Complex

Analex shall coordinate movement of payload ground support equipment (GSE).

Analex shall coordinate all launch complex access requirements including, but not limited to training, badging, security escort services, and tours.

Analex shall coordinate contractor support for off-shift operations, monitor payload activities, and reschedule support in response to anomalies and changes in plans.

2.12 Post Launch

Analex shall coordinate GSE movement, monitor customer clean-up/close-out activities, and coordinate shipping services.

3 Launch Operations Management Services

Analex shall provide launch operations management services in coordination with the NASA Launch Site Integration Manager (LSIM).

Analex shall coordinate between the Launch Service Provider (LSP), NASA Launch Director, NASA Launch Site Integration Manager (LSIM), and payload customer to produce the Launch Management Coordination Meeting (LMCM) presentation package. The Launch Management Coordination Meeting (LMCM) package shall include, but not be limited to launch day management and reporting structure; launch day “GO/NO GO” charts; list of mandatory assets for launch; launch day seating charts; launch day voice communication charts; and range conflict calendar.

Analex shall coordinate and schedule launch countdown rehearsals for the payload customer in the weeks prior to launch.

Analex shall, in coordination with the external public affairs organization, create and implement a plan to provide voice communications, video, timing, satellite up-links and down-links, and Launch Site Support Trailer (LSST) for coverage of a launch. Analex shall participate in planning meetings and teleconferences.

4 Launch Site Administrative and Customer Services

Analex shall provide secretariat function services for all launch site integration activities to include, but not be limited to the following: develop meeting minutes/actions and publish/distribute preliminary and final versions, prepare agendas and security access lists, coordinate meet-me numbers for teleconferences, arrange facility accommodations and presentation equipment, reproduce meeting materials, and record attendance

4.1 Launch Site Customer Services

Analex shall conduct the Launch Site Introduction/Familiarization Briefing for the payload customers. Analex shall prepare the briefing material to include but not be limited to familiarization/introduction of the launch site, list of points of contact, local community and center/base accommodations/capabilities, and any specific information related to facilities/equipment.

5 Mission Integration Coordination Services

Analex shall participate in each Expendable Launch Vehicle (ELV) mission through active participation of the Mission Integration Teams (MIT).

5.1 Integrated Mission Data, Documentation, and Schedules

Analex shall prepare a mission plan for each mission immediately preceding the Authority To Proceed (ATP) for the Launch Service Provider (LSP). The mission plan shall be accessible to payload customers through a controlled website.

Using inputs from the NASA Mission Integration Team (MIT), Analex shall prepare and maintain an integrated mission schedule that shall be compatible with Milestones Professional scheduling software. Analex shall evaluate mission integration schedules to identify potential schedule conflicts and inform NASA.

Analex shall maintain and NASA Payload Planner’s Guide using information provided by the MIM.

5.2 Administrative Services

Analex shall develop documentation packages (e.g. Risk sheets, Mission Integration Working Group (MIWG) presentations) for mission management and NASA Mission Integration Team (MIT) activities to include, but not be limited to meetings, briefings, reviews and other activities that are at the Agency, Program, Project, and NASA Mission Integration Team (MIT) levels.

5.3 Secretariat Functions

Analex shall provide secretariat function services for all NASA Mission Integration Team (MIT) reviews to include, but not be limited to the following: develop meeting minutes/actions and publish/distribute, prepare agendas, coordinate meet-me numbers for teleconferences, arrange facility

6 Launch Engineering Team (LET) Services

Analex shall provide technical services to the Launch Engineering Team (LET) formed to support NASA and NASA-sponsored Expendable Launch Vehicle (ELV) launches to include, but not be limited to the following:

Document, organize, and track internal and external action items that are significant to the LET in preparation for readiness reviews during the launch campaign such as Pre-Vehicle-On-Stand (Pre-VOS) Reviews, Systems

Reviews, Flight Readiness Reviews (FRR), Launch Readiness Reviews (LRR), and related technical readiness reviews.

Coordinate Technical Interchange Meetings (TIM) to include participation from offsite engineering organizations. Document, organize, and track internal and external action items that are relevant to the LET.

7 Communications and Telemetry

Analex shall provide engineering, operations, and maintenance of NASA communications and telemetry systems in all operational areas for NASA supported Expendable Launch Vehicle (ELV) missions including commercial and other payload customers of the NASA Program.

Analex shall provide technical interchange with NASA to provide status and immediately communicate any significant issues.

Analex shall be responsible for the following communications and telemetry support activities while processing at NASA and/or Commercial Payload Processing Facility (PPF)s:

- Operation & Maintenance of Communications and Telemetry Systems
- Disposition Requirements
- Engineering and Planning
- Setup and Activation
- Configuration Control
- Maintenance
- Troubleshooting
- Breakdown and Stowage

Analex shall provide troubleshooting and platform services for Expendable Launch Vehicle (ELV) customers where required. Analex shall coordinate and schedule customer requirements. Analex shall create a customer interface for data services to adapt customer equipment to the facility transport where necessary.

Analex shall permit specific equipment to remain operational and un-attended during non-supported hours when requested by NASA. Analex shall report to NASA the risks associated with unattended operation of this equipment and shall take appropriate steps to mitigate these risks.

7.1 Communications Systems

Using Installation-Provided Property (IPP), Analex shall provide the following services to all NASA customers:

- Voice
- Video
- Data
- Timing

Analex shall request and schedule communications circuits and support from the responsible organizations to meet all requirements. Analex shall coordinate directly with these outside organizations to assist in the activation and troubleshooting of these assets. Analex shall field support equipment to outfit these communications circuits to satisfy customer requirements.

Analex shall provide real-time end-to-end testing and troubleshooting of all communication links. Analex shall provide communication services for the public affairs video and audio production and satellite uplink activities for all NASA sponsored missions. This shall include all required planning of external contractor video and audio productions and technical support to interface equipment with NASA communication and video circuits.

7.2 Telemetry Systems

Analex shall provide time-tagged reception, recording, processing, and display of all incoming telemetry data. Telemetry data shall consist of: FM/FM telemetry, PCM/FM telemetry and separate analog signals. This data shall arrive via hard-line, fixed RF antenna, NASA Integrated Services Network (NISN), Internet-protocol Operational Network (IONET), or modem. Analex shall provide playback telemetry data support including displays and strip-charts as required by NASA.

Analex shall plan, develop, maintain, and troubleshoot software on the telemetry processing systems as required.

Analex shall provide analog recording and reproduction of unprocessed telemetry data and timing. Analex shall make copies of these tapes as requested by NASA and deliver them to the appropriate destination. Analex shall create and maintain a set of paper strip-chart recordings for all major tests and launch attempts, and copies of these recording will be delivered to the appropriate destination.

7.3 Upcoming Launches Scheduling, Planning, and Status Reporting

Analex shall create, maintain, and implement an integrated schedule for all the services provided for each scheduled mission.

Analex shall provide implementation plans for meeting mission communications and telemetry requirements including design drawings, procurement documentation, resource allocation, agreements with external service providers, and detailed scheduling.

Analex shall participate in technical interchange meetings to provide status to NASA and to receive customer requirements. Analex shall also conduct facility and console familiarization presentations to NASA customers.

Analex shall participate in launch readiness reviews and briefings and provide presentations during these reviews on facility and equipment readiness status. Analex shall provide readiness reports to responsible critical activity review boards and status including testing results, training, certification, hardware and software status, and procedures. Prior to each Flight Readiness Review (FRR) scheduled 5 days before launch, Analex shall provide to NASA a detailed status of all equipment and resources required for the launch. This launch status briefing shall include but not be limited to:

- Configuration of all support equipment
- Version identification of all software
- Identification of all technical leads
- Any issues/concerns which may impact launch support
- Brief summary of any equipment, resources, or services which shall be used for the “first time” to support a launch
- Brief review of any problems which impacted the last launch and the actions taken as a result of these problems
- A formal declaration of the capability to support from Analex or sub-contractor

7.4 Technical Points of Contact (POC)

For each mission, Analex shall have a single point of contact in the following areas:

- Telemetry operations,
- Real-Time data processing,
- Communications,
- RF Systems operations,
- Mission Operations Director,
- Data Impound Coordinator

These POCs shall be responsible for the following:

- Providing NASA status on contractor support for the mission,
- Coordinating operation of the service during major tests and launch attempts for the mission,
- Provide the post launch briefing for services provided for the launch,
- Provide the problem report and resolution for issues and concerns that affected mission support.

7.5 Facilities, Facility Systems, and Support Equipment

Analex shall operate and provide routine maintenance of all Installation-Provided Property (IPP). Analex shall operate lifting equipment such as cranes and hoists and perform proof-load testing. When required, Analex shall proof-load payload customer equipment. Analex shall document results and provide NASA access to data related to maintenance records, troubleshooting efforts, problem causes, and corrective actions taken, proof-test certificates, operational and test procedures, and test data records in accordance with DRD-1, Access to Contract Data, Maintenance Records.

Analex shall provide electrician services to include, but not be limited to troubleshooting, reconfiguration, modification, and general maintenance of facility electrical systems.

7.6 Maintenance Management

Analex shall identify and document immediately upon discovery all real time problems related to mission-critical and safety-critical facilities, systems, and equipment. Analex shall coordinate resolution with all affected parties, including other contractors, to ensure effective responses and to provide mitigation.

Analex may be required to provide maintenance and repair in cases where the USAF Base Civil Engineering (BCE) services where the USAF support cannot be obtained in a prompt manner.

8 Base Operations Services

8.1 Administrative Support

Analex shall provide reproduction services and operation and maintenance of reproduction equipment.

Analex shall provide United States Postal Service and Vandenberg Air Force Base (VAFB) internal mail pickup and delivery.

Analex shall obtain photo and video services from the USAF 30th Visual Flight and provide coordination to satisfy NASA personnel, customer, and contractor photo and video requirements.

8.2 Graphics Services

Analex shall provide computer and manual graphics (drafting). This shall include, but not be limited to facility and equipment illustrations, organization charts, certificates, photograph, guest badges, and guest bus placards.

8.3 Transportation Services

Analex shall manage transportation services to meet all operations requirements to include, but not limited to spacecraft servicing equipment on site.

8.4 Shipping and Receiving

Analex shall provide services to include shipping, receiving, packing and crating, pick up and delivery of supplies, materials, equipment, and flight hardware. Analex shall receive all mail, packages, and truck shipments, check for damage, and notify end user of its arrival. Analex shall provide shipment services including overnight and point-to-point package delivery.

8.5 Laboratory Services

Analex shall operate and maintain gas-sampling equipment and obtain gas samples from tube bank trailers and K-bottles and coordinate chemical analysis from USAF Chemical Laboratory.

8.6 Non-Destructive Evaluation (NDE) Services

Analex shall provide test and inspection services including in situ NDE. Analex shall provide a written report detailing inspection results.

Analex shall perform non-destructive evaluation of handling equipment after structural modification and proof-load testing. The dye penetrant inspections shall be in accordance with American Society for Testing and Materials Standard Practice for Liquid Penetrant Examination (ASTM E 1417-99). Personnel performing the evaluation shall be trained in accordance with American Society for Nondestructive Testing (ASNT) documents ASNT CP-189-1991 “Standard for Qualification and Certification of Nondestructive Testing Personnel” and SNT-TC-1A “Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing.”

8.7 Security Services

Analex shall manage all necessary services and equipment needed for security, access permits/badges, and locksmith services.

8.8 Permits and Badges

Analex shall provide area access permits/badges for temporarily assigned payload customers and other visiting personnel for access to payload or flight hardware processing areas.

Analex shall maintain records of badges issued and account for the non-issued badge stock. Analex shall assure that any person being issued an access badge has received the appropriate Safety training required for the corresponding location to be visited.

Analex shall provide controlled area permits/badges/entry authorization lists, when required by customer projects within NASA facilities assigned to Analex or sub-contractor. Analex shall verify that personnel obtaining permits, badges, or inclusion on an entry authorization list meet the requirements for unescorted access within the controlled area.

Analex shall provide badge requests for contractor personnel for access to USAF restricted areas.

8.9 Lock and Key Control

Analex shall provide lock and key control including periodic inventory of keys in the NASA/Vandenberg Air Force Base (VAFB) master key system, posting classified document containers, changing lock combinations, and maintaining key control records, for facilities where Analex has operations and maintenance management responsibility.

8.10 Security Inspections

Analex shall provide end-of-workday securing inspections for all NASA-assigned facilities, and log all security inspection efforts.

8.11 Guest Services

Analex shall receive/screen requests for visits and process/maintain records of visit requests and authorization letters. Analex shall coordinate with entry control personnel in accordance with USAF regulations to assure proper credentials are ready when the visitor arrives. Analex shall be prepared to resolve and expedite entry control problems with security officials.

Analex shall operate and maintain a system to provide foreign national escort services in support of payload operating schedules. Analex shall be responsible for providing continuous escorting and transportation services for foreign national visitors while on USAF/NASA property.

Analex shall develop and maintain visitor control lists as required for access to specific areas controlled by USAF and other contractors. Analex shall input data into the Visiting Personnel Security Database to include visiting personnel and their facility entry authorization at any given time.

9 Mission-Direct Support at Vandenberg Air Force Base (VAFB)

9.1 Payload Support

Analex shall provide transportation services for spacecraft and flight hardware to the Payload Processing Facility (PPF)s at arrival.

Analex shall provide transportation and setup services for support equipment including the Launch Site Support Trailer. Analex shall coordinate transportation and setup services with Communications and Telemetry personnel.

Analex shall operate, maintain, and setup the Spacecraft Close-out Shelter (SCS).

9.2 Clean-Room Services and Cleanliness Requirements

Analex shall prepare a Facility Contamination Control Plan. Analex shall ensure that all Clean Rooms and clean work area facilities and associated support equipment meet payload customer cleanliness requirements. Analex shall manage all clean room operations to assure customers follow all established contamination control procedures.

Analex shall provide assistance to customers in cleaning equipment prior to moving it into the clean room.

Analex shall operate and maintain clean room particle counting equipment.

Analex shall implement customer-produced contamination control plans. In the event the customer does not have a written contamination control plan, Analex shall coordinate/implement contamination control requirements with the customer.

9.3 Propellant Services

Analex shall coordinate requirements for propellant handlers ensembles with the USAF and the USAF protective equipment maintenance and operations contractor. Analex shall manage the scheduling of self-contained apparatus protective ensemble (SCAPE) and other propellant handlers protective equipment training for customers.

Analex shall coordinate the pre-operations and post-operations servicing of spacecraft fueling equipment.

9.4 Environmental Compliance

Analex shall ensure that NASA operations are compliant with all applicable federal, state, county, NASA, USAF environmental rules, regulations, and management plans. Analex shall maintain an environmental management program that closely interfaces with NASA and the USAF environmental management efforts. Analex shall act as the technical point-of-contact (POC) and maintain a cooperative working relationship with USAF who has overall environmental compliance responsibility over all.

Analex shall represent NASA position in environmental meetings/working groups and provide to NASA evaluations/recommendations about the USAF position.

Analex shall provide environmental services to NASA for environmental programs. Services include technical regulatory consultation for interface with regulatory agencies; inspection of regulated facilities and systems; preparation of permits, reports, and other regulatory documents; and development and review of environmental documentation.

9.5 Analex shall provide environmental services to NASA operations including:

- Written evaluation and assessment of projects for requirements of the National Environmental Policy Act (NEPA).
- Preparation of NEPA documentation, e.g., Environmental Assessments, Environmental Impact Statements.
- Written evaluation of processes to determine permitting requirements and preparation of permit applications when identified.
- Ensure environmental permits are current and operations are in compliance with permit requirements. Written recommendations for corrective action to correct non-compliances.
- Preparation and delivery of reports to meet regulatory deadlines, e.g., permit compliance reports, Emergency Planning and Community Right-to-Know Act (EPCRA) reports, Toxic Release Inventory (TRI) reports, etc.
- Inspection of regulated facilities and systems for compliance in all media areas. Written recommendations and track corrective action for identified non-compliances.

Analex shall be responsible for management of hazardous materials throughout their life cycle – procurement, usage, and disposal. They shall:

- Obtain approval from USAF for use of hazardous materials.
- Maintain records of storage and usage for emergency management purposes and EPCRA and TRI reporting.
- Maintain material safety data sheets (MSDS) for hazardous materials used and/or ensure that MSDS are given to central location.

- Ensure safe storage and use of hazardous materials including development of operational procedures for storage, use, and disposal.

- Control, package, and process hazardous and controlled wastes generated during NASA operations in accordance with Federal, state and local procedures and regulations.

- Provide training to NASA personnel, contractors, and customers concerning the handling and use of hazardous materials and wastes to meet Federal, state, and local training requirements. Maintain the training records in a manner compliant with Federal, state, and local requirements.

9.6 Guard Services at Vandenberg Air Force Base (VAFB)

Analex shall provide for continuous (24 hours) guard services for NASA-sponsored payloads while processing in a NASA Payload Processing Facility (PPF) per each access entry at all times. Analex shall use authorized access lists and post orders detailing a minimum of tasks to be done to meet security requirements and exercise an emergency call tree.

9.7 Access Control Monitors (ACM) at Vandenberg Air Force Base (VAFB)

Analex shall provide trained personnel to perform as Access Control Monitors (ACM) continuously (24 hours) as rquired. Access Control Monitors (ACM) shall be responsible for monitoring personnel limits in the facility, enforcing safety constraints, logging facility anomalies, contacting appropriate people in response to an anomalous condition, and operating the video and communications systems within the Hazardous Processing Facility. The Access Control Monitors (ACM) shall not perform as a security guard. In the event of an anomalous occurrence, the established call tree shall be exercised.

9.8 Satellite Uplink Services for NASA Public Affairs Support

For Vandenberg Air Force Base (VAFB) missions, Analex shall provide mobile satellite uplink services for a NASA sponsored mission to support mission-direct activities including an end-to-end communications test prior to launch day and/or a launch attempt.

10 Vehicle Engineering And Analysis

Analex shall perform engineering and analyses for the NASA Program. Analex shall review and evaluate Launch Service Provider (Launch Service Provider (LSP)) tasks and products delivered as part of each expendable launch vehicle launch service so that the NASA Vehicle Engineering Division can provide approval of mission unique items and a knowledgeable “go/no-go” for NASA missions.

As required, Analex shall prepare and deliver technical briefings to spacecraft and launch vehicle external review teams.

Analex shall have the ability to investigate and evaluate the design, modification, development, and implementation of all launch vehicle systems, ground support systems and equipment at all Expendable Launch Vehicle (ELV) and payload processing facilities and launch complexes used to provide Expendable Launch Vehicle (ELV) launch services to NASA. Analex shall review, evaluate and provide an assessment of launch vehicle systems where NASA identifies a requirement for technical insight into the development, design, manufacturing, testing, integration, and launch of the affected systems and launch vehicle.

Analex shall participate in Launch Service Provider (LSP) run reviews and payload customer reviews, which are chaired by NASA personnel, in order to provide technical evaluations and recommendations of the designs, analyses, manufacturing methods, tests, and operations presented at those technical meetings. The meetings include technical interchange meetings (TIM), mission integration working groups (Mission Integration Working Group (MIWG)), preliminary design reviews (PDR), critical design reviews (CDR), design certification reviews (DCR), Quarterly Program Reviews (QPR), Payload Planning Meetings, Payload Ground Operations Working Group (GOWG), Safety Review Meetings, Flight Readiness and Launch Readiness Reviews.

Analex shall review, evaluate, and provide technical assessment of all required Launch Service Provider (LSP) documents delivered as part of the integration of each Expendable Launch Vehicle (ELV) mission so NASA can approve items specified in the launch service contracts (e.g., Contract Data Requirements List (CDRL), Mission Integration Working Group (MIWG) minutes and action items). Analex shall be well versed in analyses methodologies used by all NASA Launch Service Provider (LSP)s. For assessments of Launch Service Provider (LSP) Contract Data Requirements List (CDRL), Analex shall provide a written report to the NASA Mission Integration Team to include a summary of the Contract Data Requirements List (CDRL) reviewed, rationale for agreement or disagreement, ground rules used for any contractor analysis performed, results and sound explanation which corroborate contractor analytic results, final conclusions and recommendations, and appropriate identification of risk and risk rating. At a minimum, Analex shall identify all significant issues that could potentially impact mission success, schedule milestones, or cost for NASA resolution with the Launch Service Provider (LSP).

Throughout the life cycle of each NASA mission, from identification of mission requirements until completion of post-launch data review, Analex shall gather data from Launch Service Provider (LSP)s and spacecraft customers as well as perform their own independent research. Analex shall evaluate and assess mission specific launch vehicle systems, mechanical and electrical interfaces, mission-specific software, predicted spacecraft environments, and Launch Service Provider (LSP) actions for NASA missions. . Contractor technical assessments shall be provided to NASA for NASA resolution with the Launch Service Provider (LSP).

Throughout the build cycle for each NASA launch vehicle, from design requirements development until completion of post-launch data review, Analex shall participate in NASA and Launch Service Provider (LSP) technical activities and take all other steps necessary to maintain a knowledge base adequate to ensure prompt, accurate and complete evaluation of all flight and ground system technical issues or anomalies effecting NASA missions. The assessments shall include documentation of discrepancies, dispositions and corrective action plans. This requires knowledge for all Expendable Launch Vehicle (ELV) systems utilized by the NASA Launch Services Program Office, including knowledge of specific vehicles assigned to NASA and to non-NASA missions. .

Analex shall gather data, review telemetry, research requirements, review as-built documentation and as-run procedures, and perform any other investigative steps necessary to prepare and present evaluations to NASA-chaired Failure Review Board (FRB) meetings in the event of a failed mission. Evaluations of anomalies shall be presented to the Kennedy Space Center (KSC) Engineering Review Board. Analex shall evaluate the failed or anomalous systems in order to aid the determination of root cause so that NASA can direct or approve Launch Service Provider (LSP) corrective action plans and/or return-to-flight activities.

10.1 Mission Analysis

Analex shall provide rapid, accurate, and complete assessments of analytical items throughout the life cycle for each NASA mission and build cycle for each NASA vehicle. Analex shall perform reviews of Launch Service Provider (LSP) provided documents in order to ensure prompt technical assessments of all relevant issues that arise during the integration process. Evaluation of these issues may require Analex to perform an independent analysis in order to verify or better understand the Launch Service Provider (LSP) data. Documentation of evaluations and recommendations to NASA shall be such that NASA approval of analyses and/or direction to the Launch Service Provider (LSP) for corrective actions can be accomplished. The analytical areas that shall be covered include the following:

- Loads and Structural Dynamics
- Dynamic Environments
- Stress
- Flight Design
- Flight Software
- Controls and Stability
- Thermal/Thermodynamics
- Electromagnetic Compatibility
- CFD/Aerodynamics

Analex shall evaluate Launch Service Provider (LSP) analyses for compliance with applicable mission and vehicle requirements for each of the disciplines listed above so that the NASA Vehicle Engineering Division can provide prompt approval of mission unique items and a knowledgeable “go/no go” for NASA missions. Analex shall evaluate and provide technical assessments to NASA of the relevant Launch Service Provider (LSP) Contract Data Requirements List (CDRL), vehicle system design, testing (such as that required for flight software or environments), robustness in the areas of performance and reliability, and post flight data.

For all of the disciplines listed above, specific technical expertise required by Analex shall include the ability to:

- Develop and create complex vehicle models
- Simulate these models using relevant code
- Modify or update analytical code as required
- Understand the Launch Service Provider (LSP) tools and models such that input and output files can be reviewed efficiently and accurately.
- Review incoming reports and perform analytical checks as required

10.2 Vehicle Systems Engineering

Analex shall provide rapid, accurate, complete assessment of vehicle systems issues and provide notification to the NASA Vehicle Systems Lead and the NASA Chief Engineer in accordance with the Engineering Review Process. Analex is responsible for reviewing and evaluating Launch Service Provider (LSP) tasks and products so the NASA Vehicle Engineering Division can provide prompt approval of mission unique items and a knowledgeable “go/no-go” for NASA missions. Analex or sub-contractor’s vehicle systems engineers shall evaluate and provide technical assessments of the Launch Service Provider (LSP) launch vehicle systems design, analyses, manufacturing, verification, validation, assembly, integration, testing, checkout, and launch preparations for compliance with applicable requirements and robustness in the areas of performance, safety, reliability, and quality.

Analex shall provide expertise in the following areas:

Electrical/Avionics Engineering: electrical wiring avionics boxes, guidance and control systems, vehicle instrumentation, vehicle telemetry, vehicle Radio Frequency (RF) systems vehicle power systems, data acquisition/handling systems and Ground Launch Control Software, and electrical ground support equipment.

Mechanical/Structural Engineering: structures, composite materials, payload adapters, mechanical separation systems, pneumatics systems, hydraulics systems, liquid and solid propulsion systems, ordnance systems, and contamination control methods.

10.3 Electrical/Avionics Engineering

Analex shall assess flight and ground Expendable Launch Vehicle (ELV) electrical and avionics systems for NASA’s determination of their readiness for launch.

Analex shall assess mission unique requirements imposed on the design, modification, development, implementation, and flight performance of all electrical and avionics systems.

Analex shall participate in, and assess launch vehicle processing, payload integration and testing activities at both the launch site and at payload customer facilities (e.g., fit-checks) to verify overall Launch Service Provider (LSP) compliance with test procedures and acceptability of test results

10.4 Mechanical/Propulsion Engineering

Analex shall assess flight and ground Expendable Launch Vehicle (ELV) mechanical and structural systems for NASA’s determination of their readiness for launch. Analex shall determine failure trends of components and investigate latent defects.

Analex shall review and assess mission unique requirements imposed on the design, modification, development, implementation, and flight performance of all mechanical and structural systems.

Analex shall participate in and assess launch vehicle processing, payload integration and testing activities at both the launch site and the payload customer facilities (e.g., fit-checks, environmental testing, payload shock testing) to verify overall Launch Service Provider (LSP) compliance with test procedures and acceptability of test results. In addition, Analex shall evaluate and make recommendations on payload mechanical compatibility drawings for human access verification.

Analex shall participate in and assess Launch Service Provider (LSP) plans to comply with mission cleanliness requirements in processing facilities, during transportation and payload/Expendable Launch Vehicle (ELV) integration, and under fairing environments. Analex shall provide expertise in materials utilization/compatibility with mission unique requirements according to contamination control plans.

10.5 Electronic Drafting

Analex shall provide electronic drafting capability to create, design and maintain 2-dimensional (2D) and 3-dimensional (3D) drawings.

Analex shall develop and maintain diagrams, schematics, modeling for accessibility and/or feasibility assessments for mission integration requirements and launch vehicle systems. Analex shall provide diagrams, schematics and modeling studies as part of the Engineering Review Process and the Mission Integration activities. Results to be supplied on hard copy and electronically to NASA.

EXHIBIT 2

Supporting Technical Data
on
Centre National d'Etudes Spatiales
CALIPSO Sensor Description

Partnership Responsibilities

NASA Responsibilities:
- ⇨ Project management
- ⇨ Launch vehicle and services
- ⇨ Payload
  - ▪ Advanced Microwave Radiometer (AMR)
  - ▪ GPS Payload (GPSP)
  - ▪ Laser Retroreflector Array (LRA)
- ⇨ Mission operation support for instruments
- * ⇨ Support of science team for research and application

CNES Responsibilities:
- ⇨ Project management
- ⇨ Lead system integrator
- ⇨ Spacecraft bus (Alcatel)
- ⇨ Payload
  - ▪ Nadir Altimeter Poseidon-3 (Alcatel)
  - ▪ Doppler Orbitography and Radio positioning Integrated by Satellite DORIS tracking receiver (Thales)
- ⇨ Ground system: launch and commissioning
- ⇨ Mission operations during commissioning
- ⇨ Long term science, data processing, archiving and distribution

OSTM - JSG
**

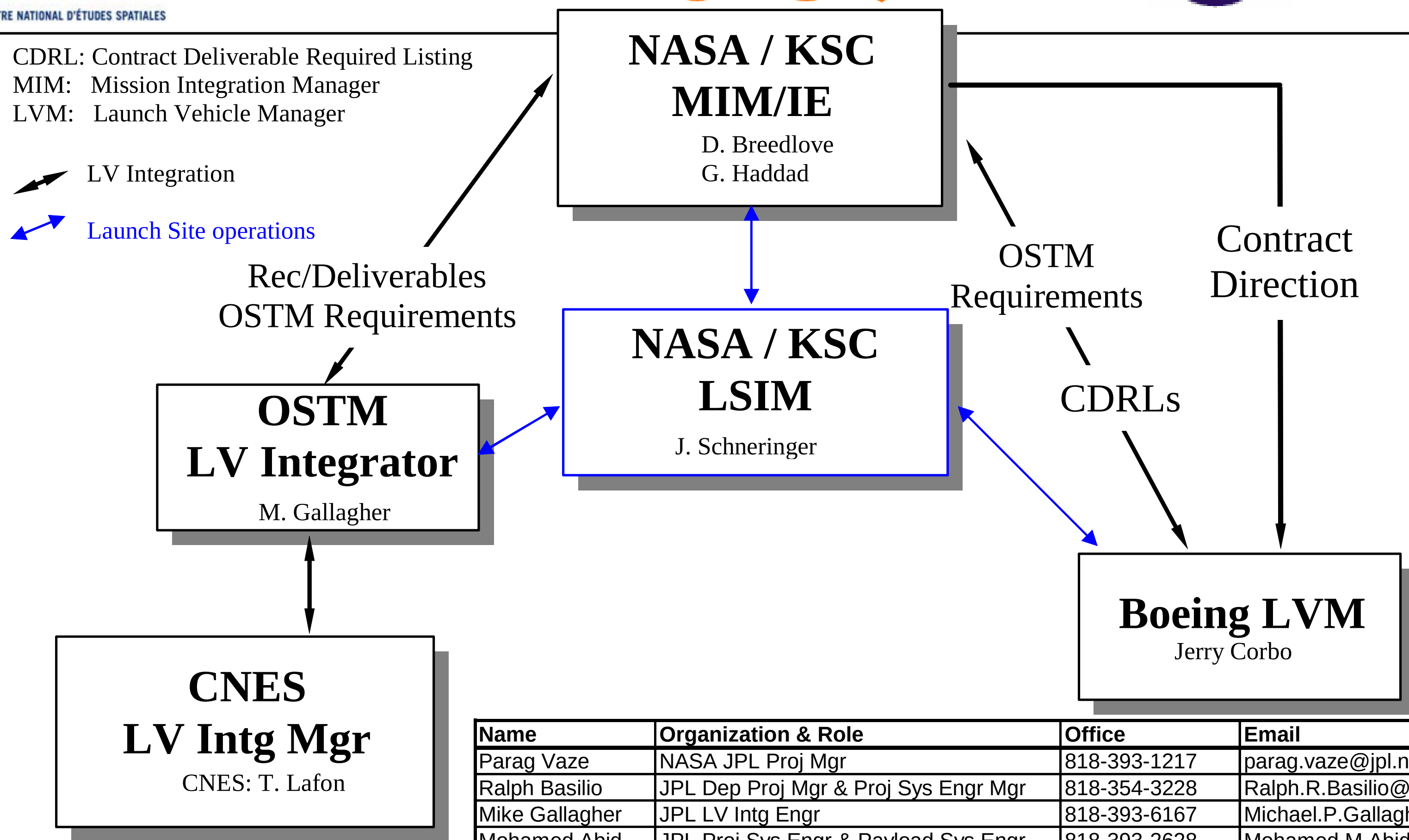
NOAA Responsibilities:
- ⇨ Project management
- ⇨ Ground system
- ⇨ Routine mission operations
- ⇨ Operational data processing, archiving, and distribution

EUMETSAT Responsibilities:
- ⇨ Project Management
- ⇨ One Earth terminal
- ⇨ Operational product processing and distribution

* - Science Team funded separately from project

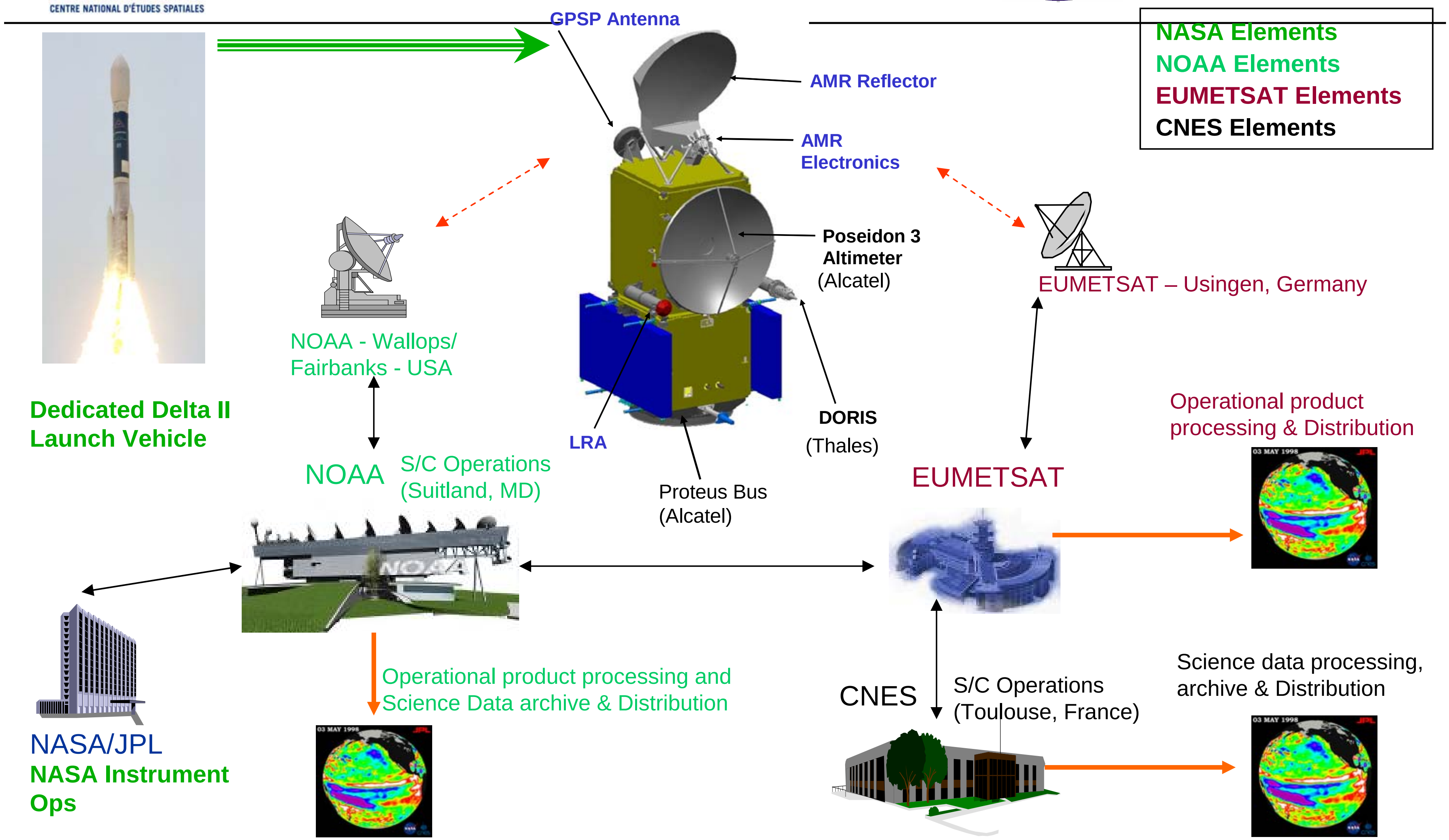
** JSG: Joint Steering Group – 4 partner, high level management council to oversee mission

Key POC and Communication Flow

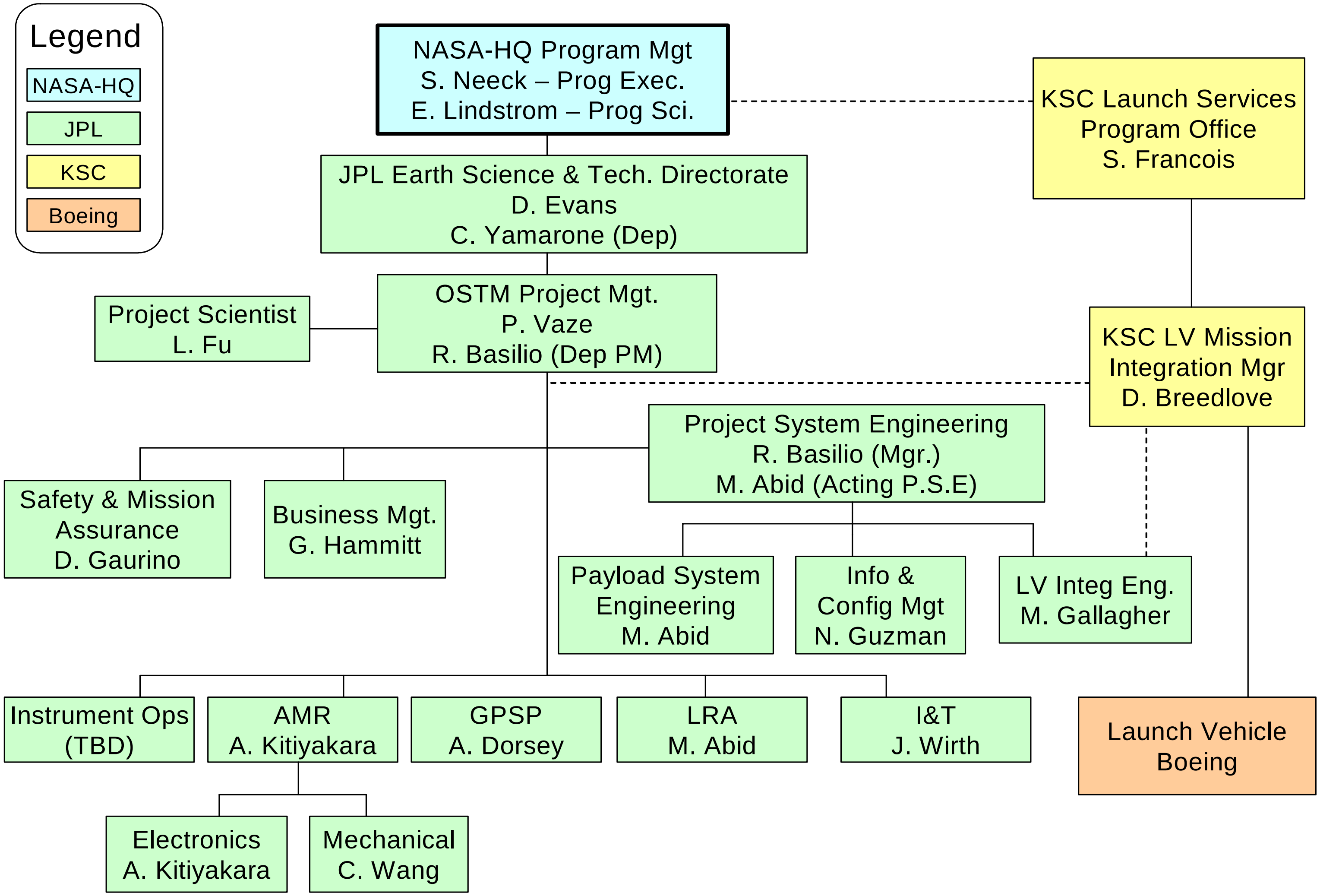


Name	Organization & Role	Office	Email
Parag Vaze	NASA JPL Proj Mgr	818-393-1217	parag.vaze@jpl.nasa.gov
Ralph Basilio	JPL Dep Proj Mgr & Proj Sys Engr Mgr	818-354-3228	Ralph.R.Basilio@jpl.nasa.gov
Mike Gallagher	JPL LV Intg Engr	818-393-6167	Michael.P.Gallagher@jpl.nasa.gov
Mohamed Abid	JPL Proj Sys Engr & Payload Sys Engr	818-393-2628	Mohamed.M.Abid@jpl.nasa.gov
Scott Michel	JPL System Safety	818-354-1424	Johnscott.Michel@jpl.nasa.gov
John Wirth	JPL Integration & Test	818-354-4270	John.W.Wirth@jpl.nasa.gov
Thierry Lafon	CNES Instrument & LV Mgr	01133561274038	thierry.lafon@cnes.fr
Daniel Vienne	CNES Jason2 Satellite Mgr		Daniel.Vienne@cnes.fr
Dave Breedlove	KSC Mission Intg Mgr	321-867-5146	David.W.Breedlove@nasa.gov
George Haddad	KSC Intg Engr	321-861-7387	George.F.Haddad@nasa.gov
Jerry Corbo	Boeing Mission Intg Mgr	714-896-4657	jerome.corbo@boeing.com

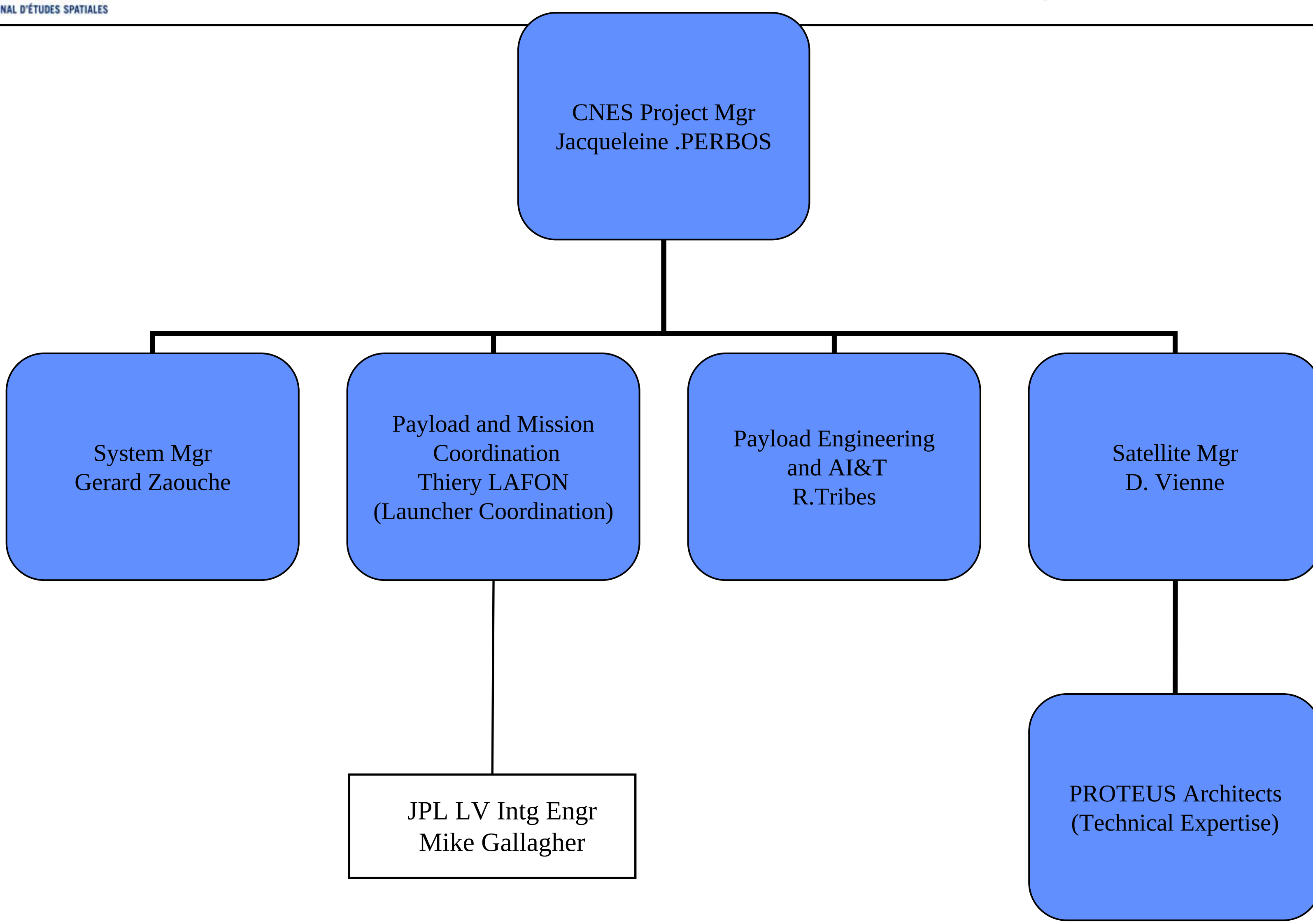
Mission and Partnership Overview



NASA OSTM Project Organization



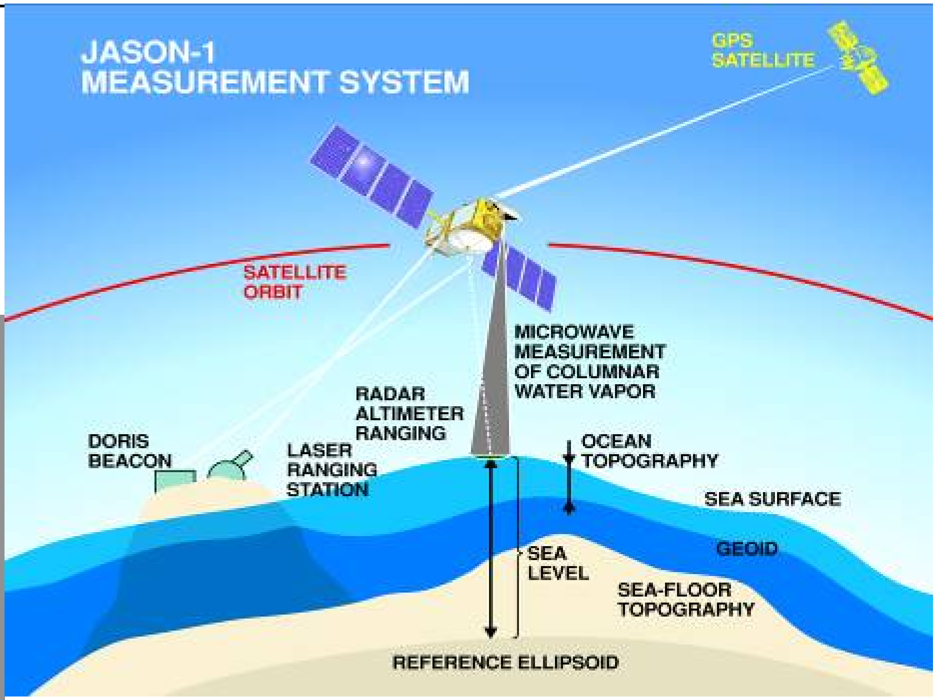
CNES OSTM/ JASON-2 Organization



Ocean Surface Topography Mission (OSTM)

Science Measurements

Global sea surface height to an accuracy of ≤ 4 cm every 10 days, for determining ocean circulation, climate change and sea level rise



Mission Objectives

- **Provide continuity of ocean topography measurements beyond Topex/Poseidon and Jason-1**
- **Continue partnership with CNES, as on Jason-1, with the addition of NOAA and EUMETSAT as operational partners**
- **Provide a bridge to an operational mission to enable the continuation of multi-decadal ocean topography measurements**

Mission Overview

- **Launch 15 June 2008**
- **Launch Vehicle Delta II 7320-10**
- **PROTEUS Spacecraft Bus provided by CNES(Alcatel)**
- **Mission life of 3 years (goal of 5 years)**
- **1335 km Orbit, 66º Inclination**

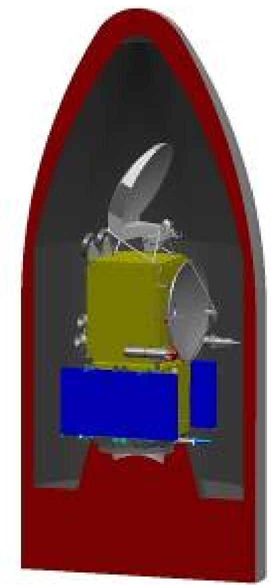
Instruments

- **Advanced Microwave Radiometer (AMR)**
- **GPS Payload (GPSP)**
- **Laser Retroreflector Array (LRA)**
- **Poseidon-3 Altimeter (Alcatel)**
- **Precise Orbit Determination Sys (DORIS)**
- **Optional DORIS Experimental Instruments (Thales)**

Description of LV and Services

Delta II manifested as baseline launch vehicle

- Single payload launch selected after cancellation of WSOA (Wide-Swath Ocean Altimeter) in Feb 05
- 7320-10 Vehicle specified
  - 3 Strap-on boosters, 2 Stage, Single payload, 10’ diam PLF
  - 3715C PAF vs. standard 6915 PAF to maintain 37” diam clampband interface
  - Single payload configuration and 10 ‘ diam PLF contributed to load factors much higher than Jason-1 PROTEUS Bus mechanical limits
    - requires a system that reduces vibration loads to the spacecraft
- Payload Integration at Vandenberg Air Force Base (VAFB)
- Implementation timetable based upon ATP (Authority To Proceed) at L-27 months (March 2006)
- NASA Flight Planning Board has selected launch date of 15 June 2008



OSTM Instruments

Payload	Description
Poseidon-3: Radar Altimeter (Alcatel)	The mission's main instrument. It provides accurate distance measurement between the satellite and the mean sea surface
Advanced Microwave Radiometer (AMR)	Measures *water vapor* content in the atmosphere so that we can determine how it impacts *radar* signal propagation. Same functional requirements as the JMR but different implementation which lead to a new generation design : lighter, less power consumption and stand alone.
Doris Tracking Receiver Package: (Thales)	Provides Precise Orbit Determination (POD). This information is essential for providing *altimetry* data.
T2L2	Experiment, not a mission critical instrument: validate the in-orbit optical time transfer wrt to functional and performances point of view.
Carmen-2	Experiment, not a mission critical instrument. It measures e- and p+ fluxes to study the influence of space radiation on advanced components
LPT	Experiment, not a mission critical instrument. It measure the radiation environment.
Laser Reflector Array (LRA)	Mission’s supporting instrument for verification during the CalVal period (~ First 6 months). Allows OSTM spacecraft to be tracked with centimeter accuracy by 40 satellite laser ranging stations. The LRA is an exact copy of the Jason LRA and has already been fabricated by INT Inc and delivered to JPL. The spare unit was the spare unit of Jason-1
GPS Payload (GPSP)	Experimental, not a mission critical instrument. Tracking system that uses GPS constellation of satellites to provide Precise Orbit Determination (POD). Used to enhance DORIS performances. With the exception of obsolete parts, hardware is identical to those used on Jason-1 TRSR (now on-orbit 4 years).

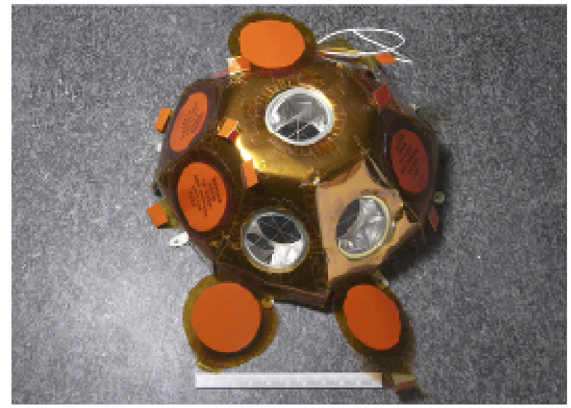
NASA instruments in blue

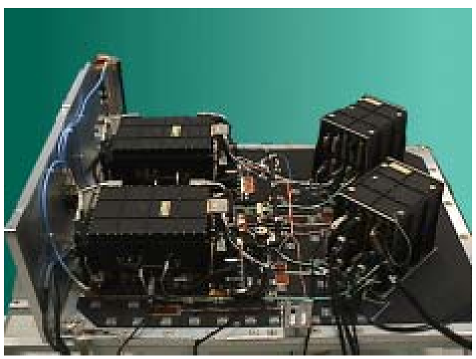
OSTM Instruments

AMR Antenna

GPS Receiver

Laser Retroreflector Array (LRA)

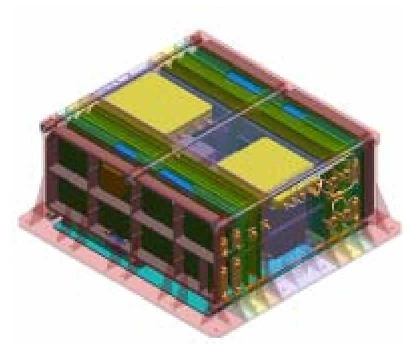




Poseidon 2-3 Ku+C
(Alcatel)

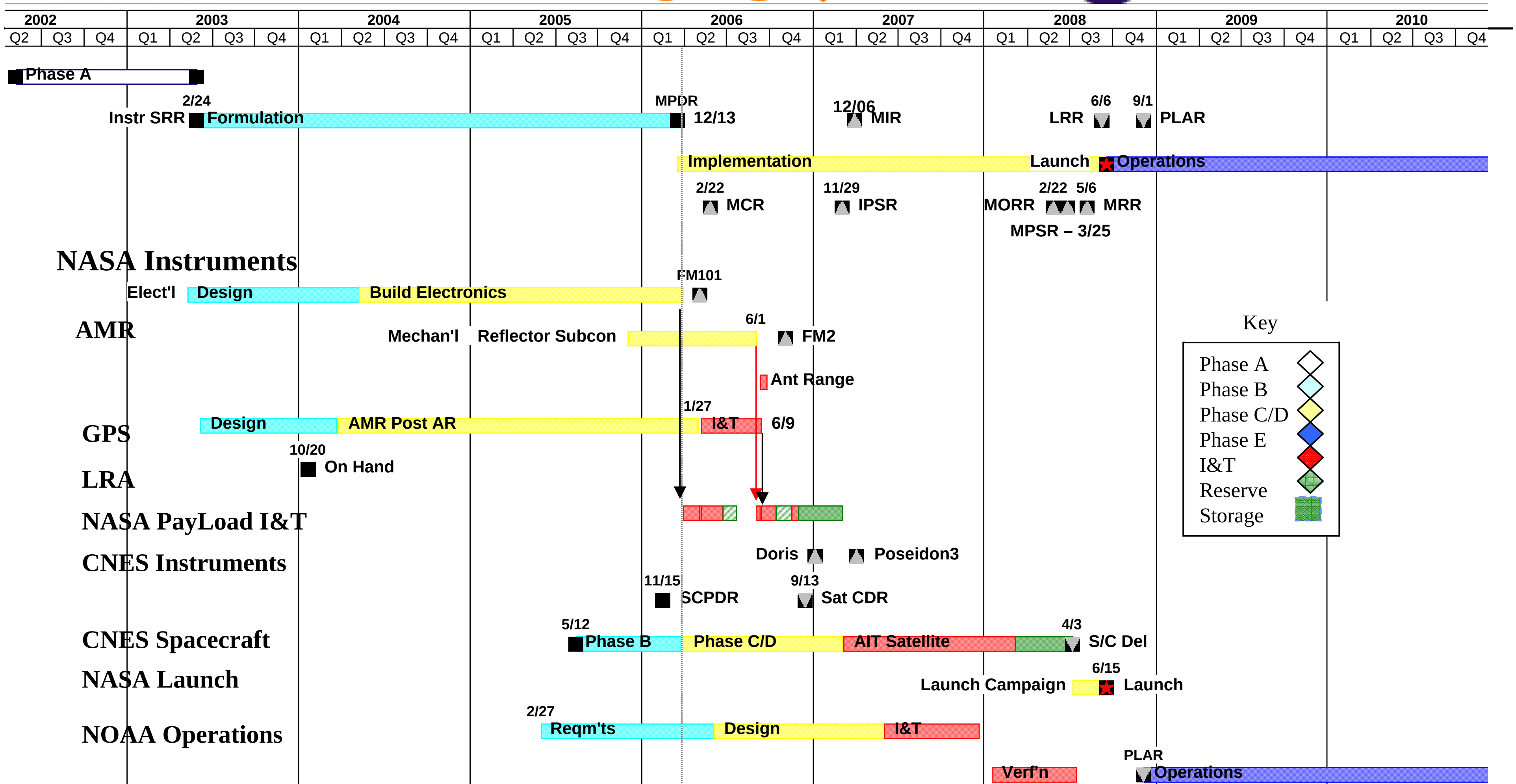
DORIS Antenna
(Thales)

DORIS DGxx BDR (Thales)



DORIS Instrument

OSTM Mission Schedule



MPDR	- Mission Prelim Design Review	LRR	- Launch Readiness Review
MCDR	- Mission Critical Design Review	MPSR	- Mission Pre-Ship Review
MCR	- Mission Confirmation Review	FRR	- Flight Readiness Review
MOS	- Mission Operations System	ARR	- ATLO Readiness Review
MRR	- Mission Readiness Review	PLAR	- Post-Launch Assessment Review
SRR	- System Requirements Review	MORR	- Mission Operational Readiness Review

OSTM/Jason-2 Observatory

- **OSTM S/C:**
  - •Evolution of generic PROTEUS platform
  - •4th of 5 production S/C built by Alcatel Alenia Space for CNES
    - •All HW procured and in storage.
  - • Baseline is CALIPSO bus design with Jason-1 payload module.
    - •Jason-1 and CALIPSO launched on top of DPAF on Delta II

- **OSTM evolution from Jason-1:**
  - •Li-ion battery + dedicated electronic
  - •New Magneto Torquer Bar (180 A/m2)
  - •New Star-Tracker Assembly (STR SODERN + carbon support) -SPOT 5 heritage.
  - •All qualified for CALIPSO
  - •Welded joint on main hydrazine tank

Jason-1

Launched Dec 2001. Still operating after successfully completing 3-year prime mission

OSTM / Jason-2

Mass: 526 kg
Power: 520 W
Altitude: 1336 km
Inclination: 66 deg

Proteus Bus (PF) Evolution – Jason1 -> 5PF -> Jason2

Recurrent design from Jason1, except for:

5PF evolution taking into account lessons learned from Jason1

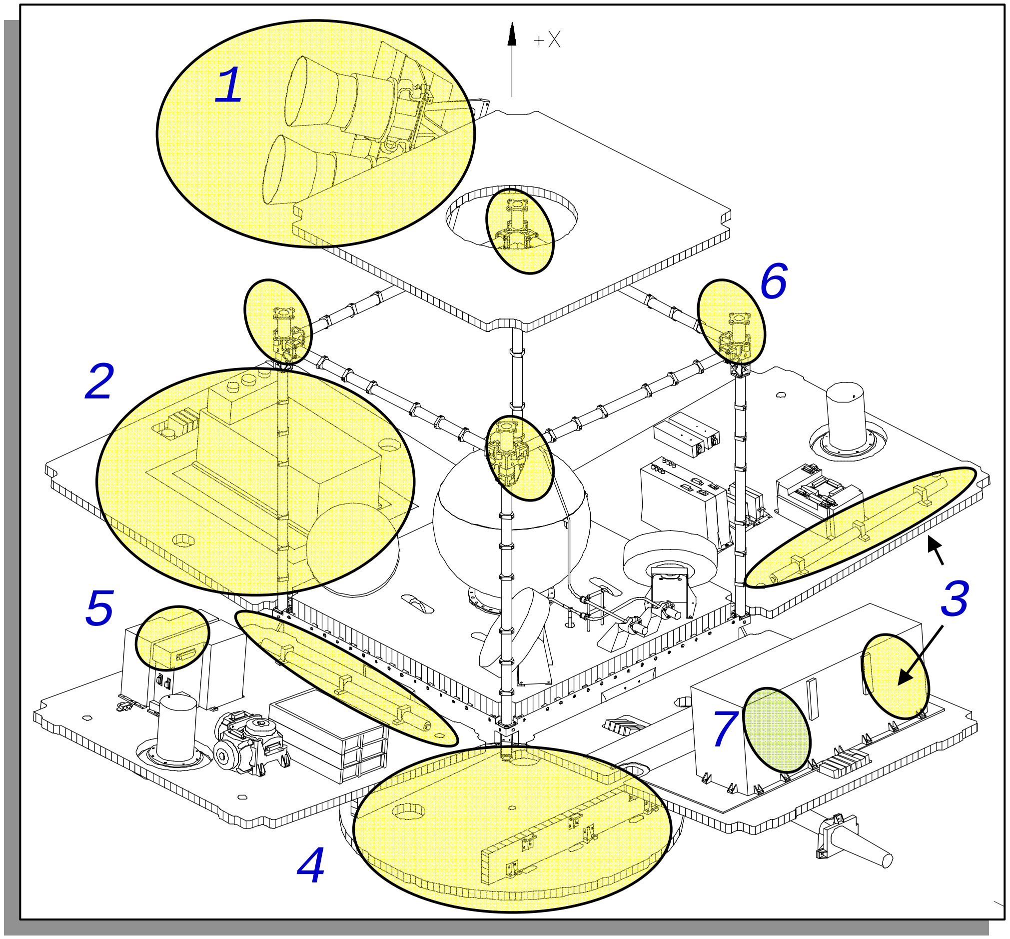
- qualified in the frame of 5PF/CALIPSO development– 5PF is a reference to the generic PF (Platform) developed after Jason1 for Calipso, Corot, Smos and Jason2

PIM structure design recurrent from Jason1

Specific evolution From 5PF to Jason2

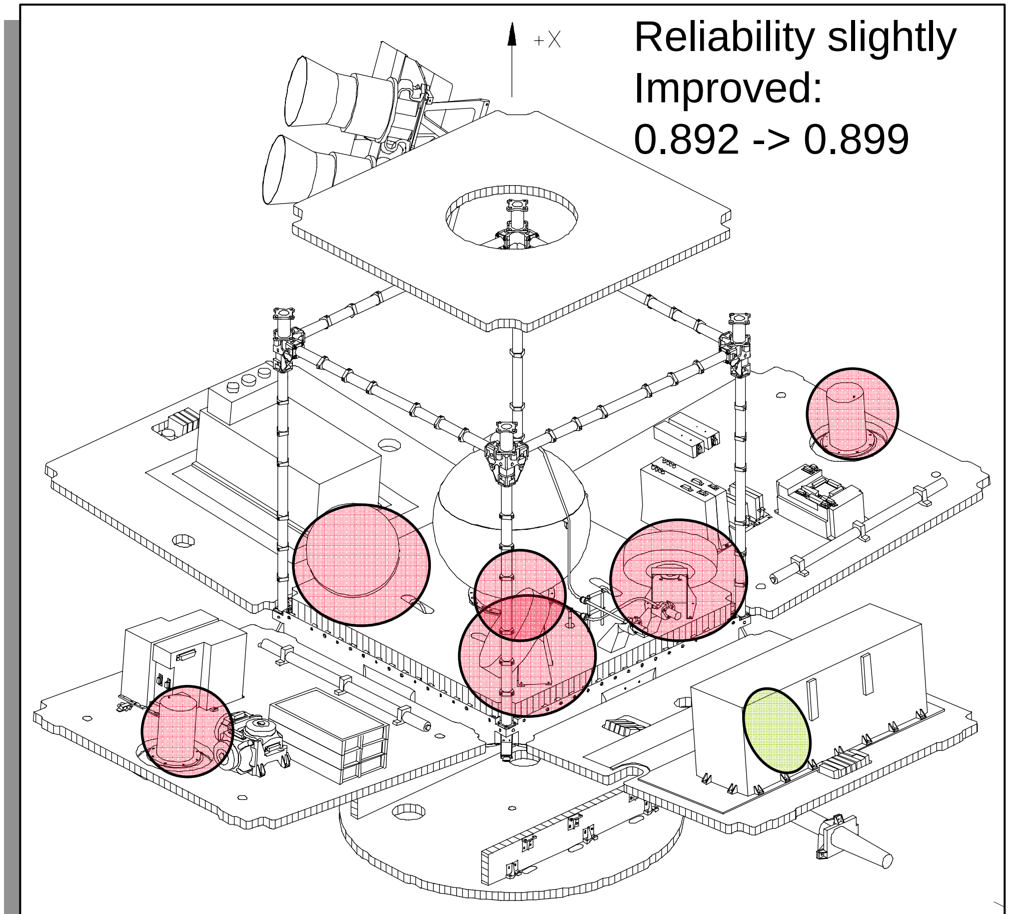
- Software customization through BDS
- Specific SW Mission needs (Diode from Doris to Altimeter, Attitude bulletin)

5PF Evolution



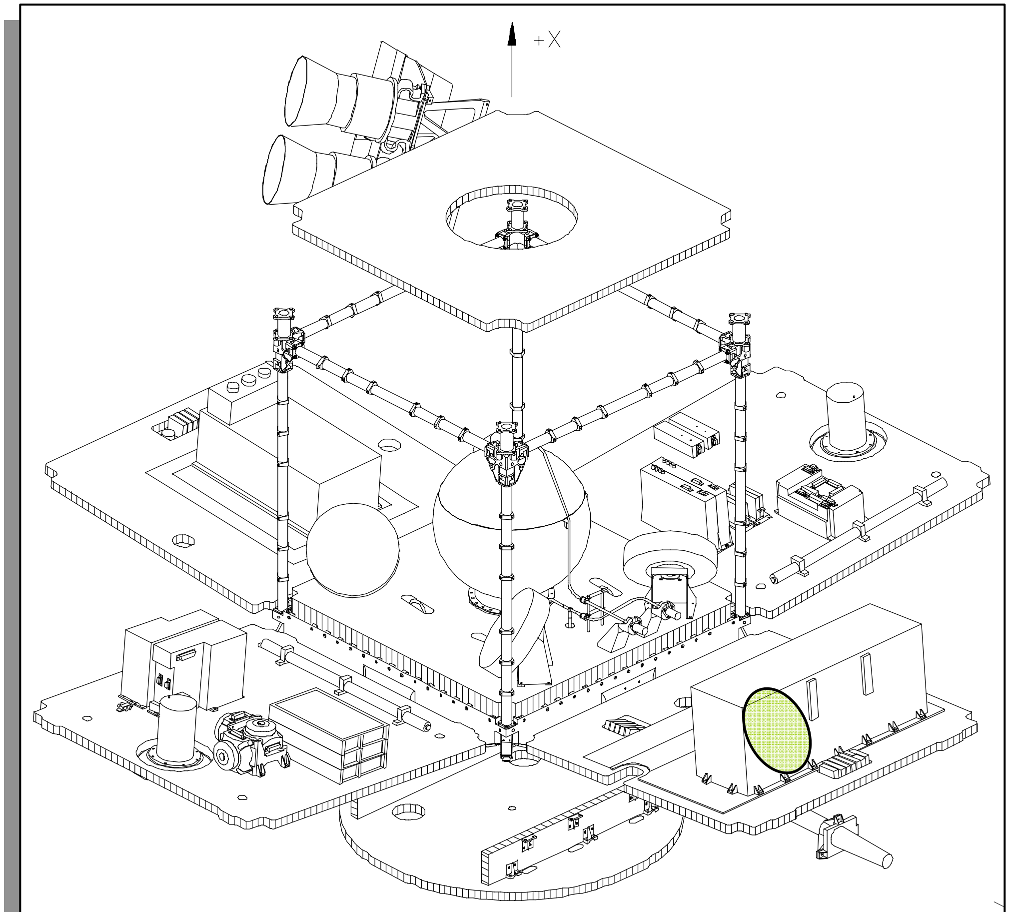
- **1- STR Sodern with STA type Calipso or Corot**
  - (Corot for Jason1)
- **2- Evolution to Li-Ion Battery**
  - Battery – BEU-
- **3- MTB 180Am2 – DHU linear current control**
  - Safe mode robustness
- **4- Standard Thruster orientation**
- **5- TM Scrambling option**
- **6- Handling pods**
  - will not be used for Jason 2 to avoid MGSE conflict
- **7- Software modification**
  - Modified equipments management
  - Many Open Works validated by 49 functional validation bench tests

Evolution CALIPSO and Follow-on



- **RW bracket stiffening**
  - Induced by MECO environment
- **Reed relays SADM**
  - To secure SA canonic position : Jason1 potentiometer in flight behavior
- **Hydrazine tank welded interface**
  - For 4th and 5th PF to decrease risk and leakage detection procedure
- **- Software modification**
  - Evolution and correction from Calipso and Corot SW development and validation
- **FEM Model Improvement**
  - Correlation after Calipso PF mechanical test, validated with COROT

Jason2 specific

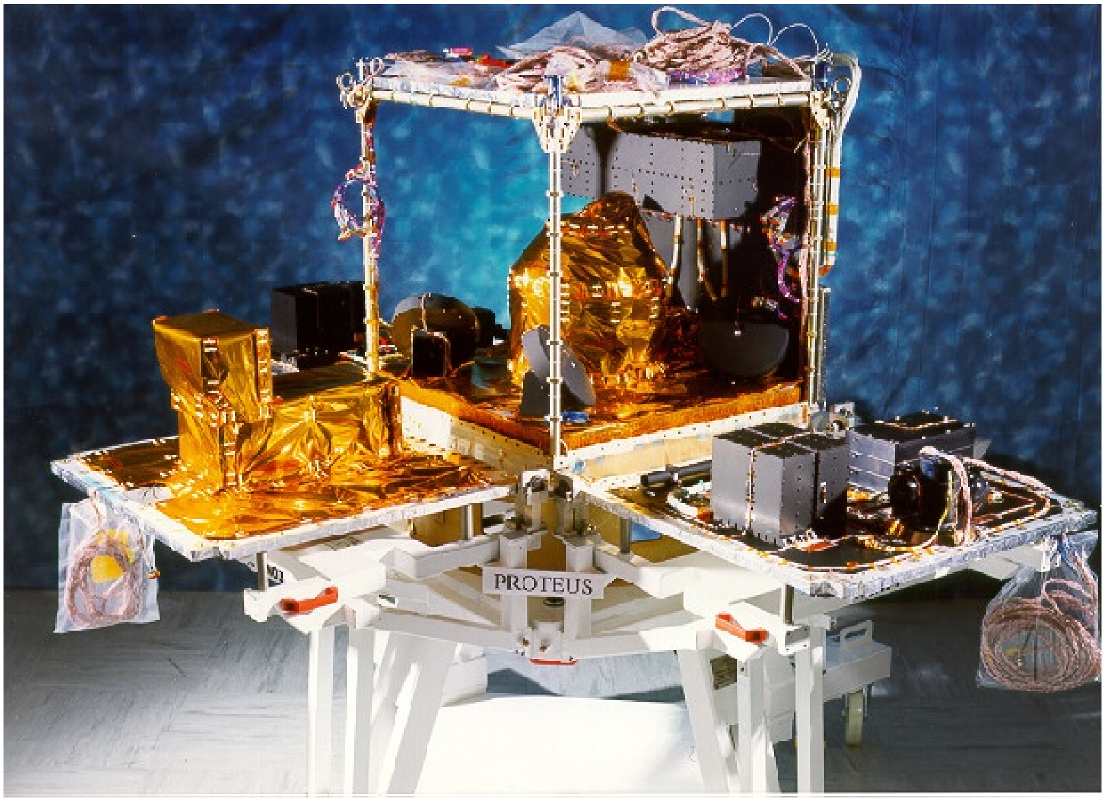


- **Only software specific change and customization by Data base**

- **Generic pods and generic MGSE for vertical and horizontal handling will not be used**
  - thanks to capability of handling by PIM upper corners(in case of problem with Jason1 MGSE, it is always possible to use generic MGSE)
- **PIM structure and bracket identical to Jason1**
  - GPSP bracket angle change
  - LRA bracket extension for T2L2
  - Accommodation (see dedicated presentation)

- **PIM FEM Model Improvement**
  - thanks to identical design with respect of PF model, the improvement benefits also to PIM model

PROTEUS Multi-Mission Platform



Orbit	Every altitude between 500 and 1500 km. Orbital inclination above 15°.
Launcher	Compatible with every launcher which has a 1.9 m diameter fairing.
Mass	Maximum platform dry mass 270kg. Hydrazin capacity 28 kg. Payload Mass between 100 and 300 kg.
Reliability	0.875 for the 3 first years. 0.749 for the rest of the 5 years.
Life duration	between 3 and 5 years according to the chosen orbit.
Pointing	Standard 0.05° for each axis.
Power	Platform maximum consumption 300 W. Payload consumption class 200 W. Up to 300 W on some orbits.
Data storage	2 Gbits for the payload
Download link	727 kbits/s

Upload link	4 kbits/s
Downtime	0.88 %

The Proteus spacecraft bus is the basic module accommodating the housekeeping instruments required for the satellite to function, as well as the dedicated mission instruments. Proteus has been developed by Cnes to adapt to different minisatellites, thus cutting mission design costs.

The generic Proteus bus, developed in partnership by CNES and Alcatel Space, was used for the first time by the NASA launched Jason-1. The generic Proteus ground segment (control center and ground station) was also specially adapted for Jason-1. It was also most recently used on the NASA/CNES CALIPSO mission.

CNES Missions (in order of launch)

Spot (satellite series)

http://smsc.cnes.fr/SPOT/

The Spot family is designed and developed by the French space agency CNES. The Spot system comprises several satellites, an orbit and mission control ground segment, a global network of receiving and processing stations, and an international product distribution and marketing network.

The spectral bands measured by the instruments have been carefully selected to match the Spot missions requirements, particularly for monitoring of crop and plant health, land management, topographic and relief mapping, ecosystem monitoring. Moreover, since Spot 2, the Doris instrument is onboard. Since Spot 4 Diode system able to localize the satellite in real-time.

SPOT1 launch : February 22, 1986
SPOT2 launch : January 22, 1990
SPOT3 launch : September 26, 1993
SPOT4 launch : March 24, 1998
SPOT5 launch : May 04, 2002

TOPEX/Poseidon (satellite)

http://www.jason.oceanobs.com/html/missions/tp/welcome_uk.html

TOPEX was a joint project between NASA and CNES. The TOPEX/Poseidon satellite carries two radar altimeters and precise orbit determination systems, including the DORIS system.

TOPEX/Poseidon laid the foundation for long-term ocean monitoring from space. Every ten days, it supplied the world's ocean topography, or sea surface height, with unprecedented accuracy. TOPEX/Poseidon was a space laboratory.

On September 15, 2002 TOPEX/Poseidon assumed a new orbit midway between its original ground tracks. The former TOPEX/Poseidon ground tracks are now overflown by Jason-1. This tandem mission demonstrates the scientific capabilities of a constellation of optimized altimetric satellites.

The mission ended January 2006.

The TOPEX/Poseidon satellite was launched on August 10, 1992

Jason-1 (satellite)

http://www.jason.oceanobs.com/html/missions/jason/welcome_uk.html

Jason-1 was a NASA/CNES partnership, launched on a Delta II from Vandenberg Air Force Base. It was launched as a dual payload with the NASA TIMED mission. **The Proteus bus was devolved for**

first use on Jason-1. It will also be used for OSTM (aka Jason-2).

Jason-1 is the first satellite in a series designed to ensure continued observation of the oceans for several decades. **It is the follow-on to TOPEX/Poseidon,** whose main features it has inherited (orbit, instruments, measurement accuracy, etc.), and was developed jointly by CNES and NASA. Satellite control and data processing operations will be performed by a new ground segment.

Jason-1 was launched on December 7, 2001.

ROSETTA (satellite)

http://smsc.cnes.fr/ROSETTA/

The ROSETTA Mission of the European Space Agency (ESA) will study comet Churyumov Gerasimenko with which the probe has a rendezvous in August 2014**.**

After a period during which a global mapping of the comet will be realized by the orbiter, a closer observation phase will follow, including the sending of a module (Lander) down to the comet.
France contribute doubly to this mission through :

- technical participations to the Orbiter (through its contribution to the European Space Agency) and to the Lander (through a cooperation with the German Space Agency DLR),
- scientific participations to the instruments on the Orbiter and on the Lander.

The launch, that took place the 2nd of March 2004 by an Ariane 5 launcher, will lead to a placing in the right orbit near the comet by August 2014 for an 18 month observation period.

DEMETER (micro satellite)

http://smsc.cnes.fr/DEMETER/

DEMETER (Detection of Electro-Magnetic Emissions Transmitted from Earthquake Regions) is the first project in the CNES MYRIADE microsatellite series.

The scientific purpose of the mission is to :

- study the ionospheric disturbances related to seismic activity,
- study the ionospheric disturbances related to human activity,
- study the pre- and post-seismic effects in the ionosphere,
- contribute to understand the mechanisms generating those disturbances,
- give global information on the Earth's electromagnetic environment at the satellite altitude.

DEMETER Launched on June 29, 2004

PARASOL (micro satellite)

http://smsc.cnes.fr/PARASOL/

Parasol is the second microsatellite in the MYRIADE series developed by CNES. It is carrying a wide-field imaging radiometer/polarimeter called POLDER (Polarization and Directionality of the Earth's Reflectance), designed in partnership with the LOA atmospheric optics laboratory in Lille (CNRS-USTL). POLDER is designed to improve our knowledge of the radiative and microphysical properties of clouds and aerosols by measuring the directionality and polarization of light reflected by the Earth-atmosphere system.

Launched by an Ariane 5 G+ from Europe's spaceport in Kourou, French Guiana, Parasol will embark on an expected two-year mission, flying in formation with Aqua and Aura (NASA), CALIPSO (NASA/CNES) and CloudSat (NASA/CSA) as part of the so-called A-Train. These satellites, to be joined later by NASA's Orbiting Carbon Observatory (OCO) in 2008, will for the first time ever combine a full suite of instruments for observing clouds and aerosols, from passive radiometers to active Lidar and radar sounders.

PARASOL Launched in December of 2004

CALIPSO (satellite)

http://smsc.cnes.fr/CALIPSO/

CALIPSO was a NASA/CNES partnership, launched on a Delta II from Vandenberg Air Force Base. CALIPSO was a dual payload launch with NASA's CloudSat mission. The current configuration of the Proteus bus was used for CALIPSO. It will also be used for OSTM (aka Jason-2).

The NASA-CNES CALIPSO mission (Cloud Aerosol Lidar and Infrared Pathfinder Satellite Observations) was selected by the NASA for the Earth System Science Pathfinder (ESSP) program to supply a unique data set of atmosphere vertical profiles measured by a Lidar on-board a satellite.

The CALIPSO satellite, which uses a PROTEUS platform, has a payload composed of one backscattering Lidar provided by NASA, a main instrument equipped of a 1 meter telescope, a visible camera, and an infrared imager which was provided by CNES.

CALIPSO flies in tandem with the A-Train constellation of satellites dedicated to the observation of clouds, aerosols and the water cycle. Also in the A-Train is their Jason-1 satellite.

CALIPSO Launched on April 28, 2006

COROT (satellite)

http://smsc.cnes.fr/COROT/

The COROT space telescope, equipped with a 4-CCD wide-field camera, will be put on a PROTEUS platform and launched in 2006 for a 2.5-year mission (at least). The project is led by CNES, in cooperation with several French laboratories and partner countries (Europe, Brazil).

COROT belongs to the PROTEUS program and has two scientific objectives :

The detection and the study of stars vibrations (stellar seismology).
The search for extrasolar planets and more particularly the telluric planets.

This astrophysical space experiment will enable to study, in two application domains, phenomena and objects never observed to this day.

COROT is to be launch at the end of 2006.

In addition, CNES has a multitude of mission currently in all phases of development.

MEGHA-TROPIQUES (satellite)
http://smsc.cnes.fr/MEGHAT/

PICARD (micro satellite)
http://smsc.cnes.fr/PICARD/

PLEIADES (satellite)
http://smsc.cnes.fr/PLEIADES/

SMOS (satellite)
http://smsc.cnes.fr/SMOS/

VENUS (micro satellite)
http://smsc.cnes.fr/VENUS/

MICROSCOPE (micro satellite)
http://smsc.cnes.fr/MICROSCOPE/

CNES Instruments (in order of launch)

GOLF/SWAN/EIT (instruments)

http://smsc.cnes.fr/SOHO/

The SOHO project, first cornerstone, with CLUSTER, of the ESA Horizon 2000 program, is part of the European contribution to international scientific programs STSP and ISTP studying the Sun-Earth relations.

SOHO is an ESA satellite launched by NASA (which also receives the scientific data through its DSN network) and which instruments have been conceived and realized by European and American scientists.

The ESA Scientific Program Committee (SPC) approved the 5 years SOHO mission extension after its nominal lifetime, which means from May 1998 to April 2003, then at the beginning of 2002, a new extension until March 2007. On May 24th, 2006, the SOHO mission as again been extended pushing back the mission end to December 2009. This fourteen years lifetime (instead of the 2 initially decided) will enable to cover the totality of a solar cycle.
French scientists are Principal Investigator for three of the twelve instruments (GOLF, SWAN, EIT) and have greatly contributed to several others (CDS, SUMER, LASCO) intended to study several aspects of the Sun : the heliosismology, the electromagnetic radiation, the plasma and the solar wind.

POLDER and POLDER 2 instruments)

http://smsc.cnes.fr/POLDER/

POLarization and Directionality of the Earth's Reflectance

The French space agency, CNES, has developed the POLDER instrument, which flew on ADEOS (ADvanced Earth Observation Satellite) in August 1996, developed by the Japanese space agency, JAXA. This was the first French/Japanese cooperative project in the area of Earth observation.

A second, identical instrument flew on ADEOS-2 in December 2002, successor to ADEOS, until October 2003.
POLDER is a wide field of view imaging radiometer that has provided the first global, systematic measurements of spectral, directional and polarized characteristics of the solar radiation reflected by the Earth/atmosphere system. Its original observation capabilities have opened up new perspectives for discriminating the radiation scattered in the atmosphere from the radiation actually reflected by the surface.

OVH (instrument)

http://smsc.cnes.fr/OVH/

OVH, acronym for OVerHauser magnetometer is a proton-precession magnetometer measuring the magnetic field amplitude.

It has been developed by the LETI (CEA) and provided by CNES and was embarked on board the Danish ØRSTED satellite, along with other instruments. ØRSTED has been successfully launched on the 23rd of February, 1999, from Vandenberg, California. The satellite is still flying and acquiring measurements of the Earth's magnetic field.

DORIS (instrument)

http://www.cnes.fr/html/_455_461_1513_.php

Doris has flown on Spot 2, Spot 3, Spot 4, TOPEX/Poseidon, Spot 5, Jason-1 and Envisat.

The DORIS system, designed and developed by CNES in collaboration with GRGS and IGN, has a dual purpose. It is used to determine the orbit of satellites equipped with DORIS receivers with centimeter accuracy using a network of ground stations as reference points on Earth. Via this system, it is also now possible to precisely tie points to the International Terrestrial Reference Frame (ITRF).

This dual capability has enabled DORIS to be used in numerous applications since 1992. The system is used in ocean or ice fields altimetry missions, studies of the shape and movements of Earth, as well as many location services.

SPI (instrument)

http://smsc.cnes.fr/SPI/

SPI Integral the Gamma Ray Spectrometer on board Integral Spacecraft.

The Integral project (INTErnational Gamma-Ray Astrophysics Laboratory), on board which is SPI instrument is dedicated to the study of gamma-rays. It was successfully launched on October 2002, the 17th.
SPI will observed with unrivalled spectral resolution and sensitivity the emissions of gamma-rays specific to nuclear reactions leading to the creation of elements within the Universe. Thus it will provide an understanding of the physical characteristics of specific celestial bodies such as supernovae, neutron stars, black holes and active galaxy nuclei.

OMEGA/ASPERA-3/SPICAM (instruments)

http://smsc.cnes.fr/MEX/

Mars Express (MEX) is the first Martian mission of ESA. It is dedicated to the global observation of the planet (surface, subsurface, atmosphere and ionosphere). The spacecraft also carried the Beagle 2 lander mainly designed to detect extinct or extent life (exobiology).

Specifically, the French contribution to this mission, consists in supplying 2 scientific instruments :

- OMEGA (Observatoire Martien pour l'étude de l'Eau pour les Glaces & l'Activité) : Visible and near-infrared spectro-imager.

- SPICAM (SPectroscopy for the Investigation of the Characteristics of the Atmosphere of Mars) : a spectrometer with an ultraviolet channel and an infrared channel.

and a strong participation to the development of a third :

- ASPERA-3 (Analyzer of Space Plasmas & EneRgetic Atoms) : Neutral atoms imagery : study the process of the Martian atmosphere loss.

CNES financed and provided the technical follow up of those instruments developments realized by scientific laboratories.

Mars Express was launched on June, 2nd, 2003 from Baïkonour by a Soyouz launcher with a Frégat stage.
The satellite realized the Mars Orbit Insertion on December, 25th, 2003.
On September 2005, 15th, ESA announced that the mission was extended for 23 additional months.

VITRUS/SPICAV (instruments)

http://smsc.cnes.fr/VEX/

Venus EXpress (VEX) is the first mission towards Venus of the ESA. It deals with the global observation of planet (ionosphere, upper atmosphere, lower atmosphere, surfaces).

The specific French contribution to this mission, consists of the supply of 2 scientific instruments :

- VIRTIS (Visible and InfraRed Thermal Imaging Spectrometer) : Visible and Infra-red Spectro-imager inherited from Rosetta.
- SPICAV (SPectroscopy for the Investigation of the Characteristics of the Atmosphere of Venus) : comprises three spectrometers, including two inherited from Mars Express (Ultraviolet and near Infra-red), and the new spectrometer SOIR provided by Belgium.

and a participation in the development of the third :

- ASPERA-4 (Analyzer of Space Plasmas & EneRgetic Atoms) : Imagery of neutral atoms: study of Venus' ionized environment.

French Co-investigators are also present on other instruments (PFS, Planetary Fourier Spectrometer) and VeRa (Radio sounder of Venus).

Venus EXpress was successfully launched on November 9, 2005 from Baïkonour by a Soyuz rocket equipped with a Frégat stage.

Plastic/Waves/SECCHI/Impact (instruments)

http://smsc.cnes.fr/STEREO/

STEREO is a NASA mission, flying several CNES instruments.
Several French scientific teams, supported by CNES, contribute to the realization of the STEREO instruments. Each STEREO satellite will be equipped with four following instrument suites :

- PLASTIC (PLAsma and SupraThermal Ion and Composition) will study solar wind and the heliospheric processes.
- STEREO/WAVES (S/WAVES) is an instrument which will follow the interplanetary radio burst,

which will study the genesis and the evolution of the radio disturbances which go from the Sun to the Earth. The LESIA is the Principal Investigator for this instrument.

- SECCHI (Sun-Earth Connection Coronal and Heliospheric Investigation)) is a set of remote sensing instruments made up of a imager in the extreme ultraviolet, two coronagraphs in white light, a heliospheric imager. These instruments will study the 3-dimension evolution of the Coronal Mass Ejections (CMEs). The IAS is implied in the STEREO program as well on the hardware (telescope imager EUVI) as for the analysis of the data (thesis co-financed by the CNES) on the data retrieval.
- IMPACT (In situ Measurements of PArticles and CME Transients) is composed of seven instruments : an analyzer of solar wind electrons (SWEA : solar wind electron analyzer), a magnetometer, a matrix of detectors of particles measuring the ions and electrons accelerated at the time the coronal mass ejection. The **CESR** develops detectors SWEA for the two satellites of the mission, except the numerical treatment unit.

The two STEREO satellites will be launched on board a DELTA II rocket from Cape Canaveral, USA, in summer 2006.

In addition, CNES has a multitude of instruments currently in all phases of development.

IASI (Instrument)
http://smsc.cnes.fr/IASI/

MIRI (instrument)
http://smsc.cnes.fr/MIRI/

HERSCHEL (instruments)
http://smsc.cnes.fr/HERSCHEL/

EXHIBIT 3

List of Technical Documents

Exhibit 3 – List of Technical Data

This table summarizes the information covered in the International Cooperation Agreement between NASA and the Centre National d'Etudes Spatiale (CNES) for the OSTM mission.
Listed in this table are the only portions Analex has potential to export.

Technical Data description
Mission Integration Working Group (MIWG), Ground Operations Working Group (GOWG) and Launch Operations Working Group (LOWG) will be conducted in accordance with the NASA Launch Services (NLS) contract. Discussion will involve the following
• Spacecraft to Launcher Interface Control Documents (ICD)
• Spacecraft/launch vehicle technical interface issues
• Technical splinters will be held as a part of the meetings on an “as required” basis
• Technical Interchange Meetings (TIMs) will be held as required on specific technical subjects/problems
• Telecons on specific topics also will be held as required
NASA/CNES Reviews & Launch Site Activities
• Flight Readiness Review
• Launch Readiness Review
• Launch Management Coordination Meeting
• Mission Dress Rehearsal
Payload processing, launch vehicle integration, and test
• Payload Requirements Document (PRD)
• Launch Site Support Plan (LSSP)
• Launch Site Test Plan
• Launch Site Procedures
• Combined System Test
Review/Comment on the following spacecraft deliverables
• P/L Launch Site Test Procedures, Final (S/C Stand Alone & Integrated S/C-L/V)
• Final Launch Window Constraints
• P/L Launch Checklist / Mission Constraints
• P/L Dress Rehearsal Requirements
Review/Comment on the following NASA deliverables
• Post-Launch State Vector
• Coupled Loads Analysis – Preliminary
• Coupled Loads Analysis – Final
• Preliminary Mission Analysis
• Final Mission Analysis
• RF link and compatibility
• Post Launch Quick Look Analysis
• FRR & LRR High Level Minutes

EXHIBIT 4

Technology Transfer Control Plan (TTCP)

Technology Transfer Control Plan
To accompany the
Technical Assistance Agreement
Between
Analex Corporation (U.S.) and Centre National d'Etudes Spatiale (CNES), (France)
for the Ocean Surface Topography Mission (OSTM)

General: This Technology Transfer Control Plan (TTCP) is intended to supply guidance and direction to employees of Analex Corporation (Analex) and its subcontractors (if any) for protecting United States technology from inadvertent and illegal transfer to foreign nationals employed by any of the parties to the subject Technical Assistance Agreement (TAA) or any other agreement concerning OSTM. To be effective, a TTCP must identify what technology may be transferred or co-developed through discussion, display, or by physical means such as paper, e-mail, or Internet. It must identify to whom such transfers may be made and it must prescribe means to report the transfers and any violations of the terms of the TAA. Lastly, it must provide a means to both train employees and record that training.

Background: The National Aeronautics and Space Administration (NASA) has negotiated a formal Memorandum of Understanding or MOU with the Centre National d'Etudes Spatiale (CNES) that has the former agree to use its launch services contract to launch the cooperatively-built OSTM; to support its operations once on orbit, checked out, and functioning; and to share the Earth science data that OSTM will produce. The MOU calls for the signatories' centers and contractors to produce a detailed breakout of the tasks and responsibilities of the parties called the OSTM Project Plan that shall be empowered by the MOU and have the force of an international agreement.

CNES will provide the PROTEUS platform and payload module; NASA and CNES will jointly provide the payload instruments; NASA will provide launch services for the satellite; CNES will provide a command and control center for the satellite, a European Earth Terminal and data processing, archiving and distribution infrastructure for the mission; NOAA will provide a control center for the satellite, command and data acquisition stations and data processing, archiving and distribution infrastructure for the mission; and EUMETSAT will provide a site and infrastructure for accommodation of the European Earth terminal, to be integrated into the EUMETSAT Ground Segment infrastructure and data processing, rolling archiving and distribution infrastructure for the mission.

Note: No ELVIS personnel are expected to interact with NOAA or EUMETSAT personnel. In the event EUMETSAT personnel are present at meetings or on email distribution, etc., Analex employees are to refrain from exporting. Such export is not authorized. Interaction with Alcatel Space employees for the OSTM mission will be covered under a separate TAA.

NASA has contracted with Analex to provide the on-site payload-to-launch vehicle integration services under the ELVIS contract with NASA's Kennedy Space Center (which operates NASA's facilities at Vandenberg AFB, California.). Analex will perform a safety and mission assurance oversight role, launch site support engineering role, a launch operations management role, a mission integration coordination role, a communication and telemetry support role, to provide technical services to the NASA/Analex Launch Engineering Team (LET), provide on-site technical, security, and administrative support and assist in the technical preparation of the spacecraft at Vandenberg AFB, California, provide mission analysis of the following analytical areas: Loads and Structural Dynamics, Dynamic Environments, Stress, Flight Design, Flight Software, Controls and Stability, Thermal/Thermodynamics, Electromagnetic Compatibility & CFD/Aerodynamics, and perform engineering and analyses for the NASA Program, which necessitates this agreement.

Analex personnel will perform the work from Kennedy Space Center (KSC), and on site at Vandenberg AFB (VAFB), California to get the launch vehicle and OSTM payload integrated and ready for launch, and will assist with other tasks required of it by the OSTM Project Plan and the ELVIS contract Statement of Work or SOW.

What may be Transferred: The TAA authorizes Analex to carry out the tasks described in the OSTM Project Plan and the ELVIS SOW during interaction with CNES employees only and for the OSTM mission only, and to permit CNES's employees to have access to the technical documents described in the TAA. Thus, ANNEXES B and C and Exhibit 2 of the TAA, as allowed in the final State Department license; i.e., the TAA in the form and with the provisos returned to Analex by the Office of Defense Trade Controls, describe the techniques, know-how, and technical data that are permitted to be shared.

Training: All Analex employees working on OSTM are required to have completed Kennedy Space Center (KSC) web based training lessons: "Basic Export Control Program," "Foreign National Visit Processing," and Technical Information Exchange." These lessons are provided in CD-ROM format for those who do not have access to the internal KSC website or the NASA SOLAR website. All Analex employees working OSTM will read the OSTM Project Plan and the ELVIS SOW. These establish the procedures they are to follow and the limits to their cooperative work with CNES employees.

All training will be recorded by the Analex Export Control Representative.

Operations: From the first moment that Analex and CNES personnel start work until the final moment of such cooperation, Analex personnel will observe the limits to cooperation that the TAA permits. Logs or other records of topics discussed, documents accessed, issues resolved, and other cooperative work will be kept up to date and will be accessible to employees, managers, and NASA alike. Where the topics discussed and the work done are clearly within the framework of the TAA, these records need not be elaborate or detailed. Where there is any question of whether or not the material worked with falls within the bounds of the TAA, then detailed records of what was discussed, with whom, when, and where must be made. Such records must also be available as before, but it is the responsibility of the senior employee involved to make the Analex PM aware of the matter as soon as possible. If at any time any Analex employee is uneasy about what is being done or discussed, it is perfectly appropriate for the employee to terminate the activity at once and report it to the Analex PM or such person as the Analex PM has designated to receive these reports.

Physical security will be provided by NASA and Analex in accordance with the procedures specified by the Commander, 30th Space Wing, USAF. These procedures are stringent and call for 100% escort for all foreign nationals while on Vandenberg AFB. Compliance with these procedures supports this TTCP.

NASA has published its direction, procedures, and guidelines in NASA Program Directive (NPD) 1371.5, Coordination and Authorization of Access by Foreign Nationals and Foreign Representatives to NASA and NASA Program Guidance 1371.2, Coordination and Authorization of Access by Foreign Nationals and Foreign Representatives to NASA, use of which is mandated by the ELVIS contract. NASA has also implemented an automated visit control system, the NASA Foreign National Management System (NFNMS). NASA's processes for handling foreign nationals call for checks of various U.S. Government agency lists to determine if individuals have been listed as barred from doing business with the Government or are otherwise to be carefully watched. NASA visit processes will be used to manage visits by CNES personnel to Vandenberg and to meetings, etc., held on the subject of OSTM. Compliance with these procedures supports this TTCP.

KSC Procedures for foreign national access to KSC and CCAFS are contained in Kennedy Handbook (KHB) 1610.1, KSC Security Handbook, Section 406. These call for a Technology Transfer Risk Assessment (TTRA) for visitors from certain countries and for any visitor who will be on station more than a total of 30 days in one year. This procedure is specifically extended for CNES personnel working at Vandenberg for more than 30 days in one year. Compliance with these procedures supports this TTCP.

Recording: All records, logs, notes, etc., that result from the operation of this TTCP will be maintained under the control of Analex' Empowered Official for five (5) full years after the expiration date of the Technical Assistance Agreement; i.e., five years from March 31, 2011.